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TOWARD A POLICY FOR ADMINISTRATIVE COMPUTING IN THE NATIONAL SCHOOLS OF SRI LANKA

BY

© INDIRA LILAMANI GINIGE

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL ADMINISTRATION

EDMONTON, ALBERTA

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ABSTRACT

This study aimed at providing research-based advocacy for the introduction of administrative computing in the national schools of Sri Lanka. As a first step in achieving this end, the literature on change, administrative computing, and policy was reviewed to arrive at a suitable conceptual framework for the study. Next, the history of computing in Sri Lanka was studied to identify how computer technology originated and developed in the country, and also in education. Administrative problems encountered by principals of the national schools were identified next, and matched with the potential of the computer to establish a rationale for administrative computing in these schools. Then, computing practices of a number of countries well advanced in educational computing were reviewed to identify and analyze the conditions under which these countries have used computers for school administration, the issues they have encountered, and how the issues have been addressed. The knowledge so generated was used ultimately to establish a suitable role for computer-assisted administration in the national schools, and to formulate a policy for the introduction of computers in the same schools.

Analytical research that describes and interprets the past from available sources provided the methodology for this study. Document analysis was the technique used for data collection. Content analysis was used to condense the data and to bring it to a form amenable to analysis.

The model developed for implementation in the national schools incorporated seven subsystems on students, teachers, curricular and extra-curricular activities, finance,

facilities and equipment, support services, and office applications. These drew on four types of data - descriptive, diagnostic, predictive and prescriptive. The administrative applications discussed under the subsystems were further analyzed to identify simple applications primarily operational and urgently needed by the national schools as implementation priorities.

The policy ultimately formulated addressed a number of policy issues in the issue areas of people, technology, and management. The strategies selected for resolving these issues paid heed basically to the who, what, when, where, and how aspects of the issues. The people-oriented issues dealt primarily with recruitment, retention, motivation, and training of staff. Selection, acquisition, maintenance, utilization, and renewal of hardware and software were the major concerns in the area of technology. Managerial issues dealt with the four basic aspects of management - planning, organisation, direction, and control. The policy developed also addressed a number of concerns in the areas of finance and research.

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Chapter 1

Introduction

Background to the Study

Since the late 1960's, breakthroughs in the computing industry began to occur at an unprecedented pace. Computers became smaller, more reliable, easier to use and less expensive. Their presence in business, industry, education and the home widened as a result, and computers began to revolutionize the life and work of people much more than any other modern equipment.

Computers today have generated an explosion of interest in all concerned with education. This is a trend that has a high likelihood of continuing into the 21st century. Glen and Carrier (1986) found it the duty of school reform advocates at the national level to envision technology as part of the solution for improving school quality. The need and concern thus emerging for the use of computers in education require that the capabilities of computers be identified in full and utilized optimally in schools.

All schools are complex whether they be large or small, urban or rural. Just as the class teacher is compelled to make hundreds of decisions every lesson, the principals, deputy principals and other staff with managerial responsibilities are faced with the need to make frequent decisions and to act quickly on them. Administrative data processing applications that assist here, according to Spuck and Bozeman (1988), have long preceded instructional computing in the schools of the developed world. By the late 1950's, most large school districts and universities had begun to use mainframe systems for a variety of administrative purposes. Today almost all educational organisations in developed countries routinely use computers of all sizes for day-to-day management.

The rapid introduction of computers for school administration in the developed world has given impetus to the idea that computers might be useful in the administration of at least some larger schools in the developing world. According to Fullan, Miles and Anderson (1988), the effort necessary to implement administrative computing is also not as enormous as that of instructional computing. Implementation of the former requires less change in roles, methods and structures, and a manageable range of software types when compared to the latter. Research finds that implementation of instructional computing spreads more rapidly in schools where computers are being used for administrative purposes as well. Fullan *et al* (1988) identified administrative computing as a useful strategy for increasing the commitment of principals to new educational technology. In spite of these benefits no attempt whatsoever has yet been made to adopt computers for school administration in Sri Lanka.

The introduction of computers for school administration is intended to replace the manual methods of information processing with more effective computerized methods. This may enable large amounts of data to be collected regularly, stored systematically, updated quickly, processed accurately and consistently, and communicated rapidly to all who are in need of them. The change to a computerised system can also relieve teachers of time-consuming administrative tasks, and provide them with more time for meeting curricular needs. Effective computerisation of the routine workload of school principals also provides them with time and information to take a more proactive, forward looking stance, anticipate problems, make suitable decisions, and engage successfully in the important task of school development.

The shift from a manual system of school administration to a computerised system needs informed decisions for success. To facilitate such decisions, the top level administrators of the country have to be guided in the formulation of policies and organisational plans for the acquisition, operation and management of computers. The experiences of the educationists of the developed world are considered important in all such efforts not merely to avoid pitfalls, but also to make better progress toward the desired end.

To make the expected change fruitful, the paths trodden by those experienced in educational computing have to be identified in full, studied in detail, and analyzed carefully in relation to the circumstances prevailing in the country under concern and the needs of the school administrators within it. Thus, a pressing need exists today to survey the state of affairs in the domain of administrative computing to provide policy makers of Sri Lanka with valid and reliable policy information for the adoption of computers in school administration.

Statement of Purpose

The purpose of this investigation is to generate policy relevant information, and to provide research-based advocacy for the adoption of administrative computing in the national schools of Sri Lanka. As a first step in achieving this end, the researcher reviewed the history of computing in the country as a whole to identify how computer technology originated and developed in its educational context. Later, computing practices of a number of countries well advanced in educational computing were reviewed critically to establish a rationale for the introduction of computers in the national schools of Sri Lanka. An attempt was also made to identify and analyze how, and under what conditions these countries have used computers for school administration, the issues they have encountered, and the ways in which these issues have been addressed. The knowledge thus generated was used ultimately to formulate the needed policy. More specifically, the study was intended to obtain information relevant to the following research questions.

1. How did computer technology originate and develop in the Sri Lankan educational context?
    1.1 Why do developing countries need computers?
    1.2 What policy initiatives have guided the adoption of computers in Sri Lanka?
    1.3 How is the school system of the country organised and governed?
    1.4 What basic trends in educational computing have been observed in the country?
    1.5 What is the current status of academic and administrative computing in the Sri Lankan educational context?

2. Why do national schools of Sri Lanka need computers for school administration?
    2.1 What is the structural and functional organisation of national schools?

2.2 What are the most important administrative problems in national schools?

2.3 Can computers solve the above administrative problems in national schools?

3. What is the role of the computer in school administration?

3.1 Why should educationists be aware of the role of the computer in school administration?

3.2 What factors should be considered in determining the role of the computer in school administration?

3.3 How have schools in other countries used computers for school administration?

3.4 How should national schools use computers for school administration?

4. What information guides policy formulation for the acquisition and use of computers in school administration?

4.1 What policy issues have the educationists of other countries encountered in educational computing?

4.2 What policy alternatives have been identified for the resolution of the issues?

4.3 What policy actions have been adopted?

4.4 What policy outcomes have been observed?

4.5 What judgements have been made on policy performance?

5. What should constitute a draft policy for the adoption of computers in national school administration?
    - 5.1 What mission statement guides the policy formulated?
    - 5.2 What rationale underlies the adoption of computers for national school administration?
    - 5.3 What is the policy for the adoption of computers for national school administration?
    - 5.4 What guidelines accompany this policy?
    - 5.5 What indicators of effectiveness help assess policy performance?
    - 5.6 What plan facilitates the implementation of the policy?

Importance of the Study

The technological revolution, according to Mills (1987), has raised a fresh set of policy issues that promises to have a serious impact on the existing policy structures. To cope with these critical issues, Coombs and Hallak (1986) saw the need for a much more comprehensive and dynamic approach that identifies the evolving needs, and invests thought, time and money to meet them both efficiently and effectively.

This study was intended to develop clear policy guidelines for the adoption of computers for school administration, mainly on the basis of experiences of others. Such an effort has a multitude of advantages. First, it provides a suitable way for the transfer of the accumulated knowledge and know-how in the area of educational technology. Second, it prevents the history of the development of hardware and software, and the mistakes experienced by the leaders of the technological revolution in the developed world from being repeated in the developing world. Both these are likely to bring about rapid change in the national schools of Sri Lanka making it easier for these schools to achieve their goal of excellence.

For any type of innovation to be successful, all constituencies must share the same vision. If this vision is based on emotion, impatience, ignorance and whim, as opposed to a systematic analysis of technological need, the result may be a general failure of the implementation. This, according to Willis (1990), can negatively impact future technological initiatives and limit the effectiveness of the institution. The policy approach adopted in this study is important in the sense that it avoids hasty, unplanned actions of technological adoption. Adequate forethought and planning is likely to generate high quality technological decisions which may minimise the risk in adopting computers for school administration.

Administrative computing, according to Spuck and Bozeman (1988), is still an ill-defined area without an empirical/practical, or a research-based body of knowledge. The various analyses conducted in this study for the formulation of the needed policy are helpful in overcoming this situation. Formulation of policies in a systematic manner also encourages attention to the cross-impacts among the multiple components of sector-wide innovations, which according to Chapman (1991), if neglected, can undermine the change. Moreover, as Ilabaca (1991) noted, the specific policies developed for the adoption of computers for school administration prevent individual school districts from implementing their own policies with little co-ordination.

Formulation of policy on the selection and implementation of technology is a worthwhile initiative with many benefits for the stakeholders. The final outcome of the study, a set of policy recommendations, provides ample opportunity for educational policy makers of Sri Lanka to benefit from the results of detailed research on policies of other countries. This is likely to bring about better quality policy decisions that may have longstanding positive effects on the entire system of education.

Policies, according to Gathercoal (1991), serve as rules or precedents, provide standards for action and decision making, and act as instruments for communication. They also guide staff toward the achievement of desired objectives, furnish guidelines for those to whom responsibilities have been delegated, and help avoid undesirable decisions and misuse of authority. Moreover, carefully written policies improve accountability on the part of school personnel and provide different stakeholder groups with a sound and reliable base for supporting the change.

The manufacturers of computer hardware and software also benefit directly from the availability of policies for school-based computing. In the presence of clear policy guidelines they may find it easy to develop a clear vision regarding future technological demands of schools. This may enable them to evolve worthwhile marketing strategies, and to develop hardware and software that are acceptable to schools.

In the presence of clear and well thought-out policies, the research agencies may find it easier to assess the effectiveness of the proposed change, and to look into ways and means of furthering the policy processes adopted. Precise objectives and well defined tasks derived from clear policy directives, also equip top level administrators with a suitable yardstick to judge the progress of the innovation they have initiated. Such assessments also enable them to refine their policies and plans in an appropriate manner for better results in the future.

According to Mawara (1986), a policy on computing, even if tentative, must always be formulated so as to guide the acquisition and use of vital equipment and related resources. This is particularly important since computing involves heavy capital expenditure and human resources in keen competition with other sectors of the economy. Good policy decisions eliminate many likely difficulties and lead to readily implementable plans. Planned action facilitates proper co-ordination and systematic control of the computer resources. Plans also protect the users from tolerating unsuitable hardware and software, spending money on unnecessary hardware, and from involving themselves in frustrating searches for trained personnel who can effectively use the machines. Plans based on suitable policies further minimise costly consequences of malfunctions and help in the effective management of the expensive resources involved. Moreover, they clarify role ambiguities which otherwise would widen and become unresolvable, and bring down the anxiety of school personnel regarding issues pertaining to privacy, job security, and equal educational opportunity.

Delimitations

The study was delimited first to educational administrative computing which is only one aspect of educational computing. Second, the policy analysis conducted in the study concentrated on an implementation policy rather than on an adoption policy. Next, policy formulation for the study was based solely on the experiences of others well ahead in educational computing, and the policy drafted counted largely on expert opinion. Both of these postpone political inputs to a later stage in the policy making process. The methods used to collect data were also limited to documentary analysis. Moreover, the policy options the study recommended are appropriate only for policy formulation in one particular country. The study also aimed only at developing policy options and not on testing them.

Limitations

The study focused on administrative computing at the school level. The policy options finally recommended, therefore, may not be applicable to other aspects of educational computing. The study also relied heavily on written records which may reveal only part of the total picture. Moreover, the outcomes of the study are time bound, and rapidly changing conditions can make these findings obsolete. The contextual backgrounds within which the developed countries undertake educational computing also may have little relevance to that of the country to which the findings of this study are to be generalized.

Organisation of the Dissertation

Chapter 1 introduces the background to the study along with its purposes, significance, delimitations and limitations.

Chapter 2 introduces a number of concepts from the literature on change, administrative computing and policy, and builds up the needed conceptual framework for the study.

Chapter 3 describes the methodological framework of the study. The research method selected is discussed here together with the data needed for the study and procedures used for data collection, organisation, analysis, and interpretation. Concerns about trustworthiness and ethical considerations are two other aspects discussed.

Chapter 4 explains computing trends in Sri Lanka in general, and examines the current status of educational computing in the schools of the country.

Chapter 5 provides arguments as to why computers should be taken seriously and utilised effectively in the administration of national schools of Sri Lanka.

Chapter 6 defines the role of the computer in school administration in general, and illustrates some priority applications for national schools of Sri Lanka.

Chapter 7 identifies and analyzes people-oriented issues in educational computing.

Chapter 8 brings to light some important considerations pertaining to hardware and software.

Chapter 9 identifies and analyzes managerial issues that have to be addressed in technology-related innovations.

Chapter 10 recommends a policy for administrative computing in the national schools of Sri Lanka.

Chapter 11 presents conclusions and recommendations.

Chapter 2

The Conceptual Orientation

Introduction

People who plan innovations are pre-occupied with the content of change. This idea, according to Fullan (1982), results in neglect of both interpersonal and conceptual/ organisational aspects that are very important for the success of any change. Selecting and adhering to a suitable conceptual model, however, can eliminate this barrier to progress. A number of concepts and processes needed to be clarified in trying to arrive at a sound conceptualisation for this study. The first three sections of this chapter outline some of these concepts and processes identified respectively from the literature on change, administrative computing and policy. The conceptual knowledge thus gained is used in the final section to build up a suitable conceptual framework for the study.

Contributions from the Literature on Change

Fullan (1982) identified change as a difficult socio-political process which is neither totally rational nor totally predictable. Change in the context of a school helps the school accomplish its goals more effectively by replacing some of its programmes or practices with better ones.

Schools voluntarily undertake change that improves their image. Nevertheless, a need exists to impose those changes that are multi-faceted and complex in nature. The degree of centralization demanded by this type of change makes it more amenable to programmatic, explicitly defined solutions rather than to adaptive, incremental solutions.

Centralised systems encourage homogeneity across a large number of schools. Heterogeneity, which allows for adaptation and variation, is desirable to meet specific needs of schools and to gain user acceptance.

The literature points to many educational reforms that have failed in the past. Most of these have been adopted piecemeal, without questioning their need, feasibility, and technical soundness. Little attempt has been made to obtain a concrete image of the nature of the change or to figure out pictures of desired utilisation or to arrive at their organisational implications. With centralized systems in control, the schools also have had little latitude for variation to meet their specific needs.

For the development of sound programmes that are also flexible, Fullan, Miles and Anderson (1988) identified the need for clear policy direction and agreement on desired outcomes. According to Fullan (1982), many limitations, however, exist in the technical development of policy. Policies in many instances are stated at a general level to avoid conflict and to promote acceptance and adoption. Such policies neither pay attention to those factors that support or inhibit change nor indicate how implementation is to be addressed. Leaving innovations unspecified in this manner increases the potential for misunderstanding and leads to confusion.

Managing complex change requires thinking of and addressing more than one factor at a time. According to Fullan (1982), single, segmented solutions directed at one factor in isolation generate minimal impact. Capitalising on the experiences of others reduces many unforeseen factors, and helps identify and deal with all possible conditions that affect different facets of a problem.

Since all serious change entails anxiety, and the introduction of computers for school purposes is no exception, explaining the change becomes important for its success and assimilation. To avoid confusion, alienation, or simply ignorance on the part of participants at a later stage, the processes that lead to change need to be justified and their expected outcomes communicated clearly to all concerned.

Over the past decade considerable knowledge has accumulated from research and practice on how to implement educational change. Implementation, according to Fullan *et al* (1988), is a developmental process of change that involves alterations in materials, behaviours and practices, and beliefs and understandings. Among the above three areas, the first is the most obvious, and the least problematic.

Fullan *et al* (1988) analyzed the circumstances of computer implementation within a framework of factors known to affect planned change. The objective was to identify critical implementation issues, and to construct an implementation support strategy that addresses the concerns. The nature and effects of these factors are discussed below.

Clarity and complexity: The degree of difference from existing practice, material and beliefs, and the difficulty of learning new tasks determine innovation complexity. Written policies, participation in innovation development, and on-going training clarifies the meaning of change for those involved along with ways and means of putting it into practice.

Consensus / Conflict: For success, those expected to carry out a change have to agree on the need for the change as well as its appropriateness and importance. Consensus is also required on activities to be undertaken, methods of performing these activities, and equipment and material to be utilized in the process.

Quality and Practicality: A balance needs to be struck between the quality and practicality of the innovation. Practical innovations are those that address salient user needs, include concrete how-to-do-it information, tie closely to the implementing organisation's capacity for change, and demonstrate cost-effectiveness.

Central office direction, commitment and support: Implementation is more likely to happen when administrators demonstrate their interest for the change, and provide clear communication and consistent pressure. Administrators also have to establish clear responsibility; create a supportive climate; provide assistance in terms of training, release time and materials; and recognise those who make progress.

Process for implementation and institutionalisation: Innovations achieve institutionalisation when their effectiveness is proven. A clear implementation model that is conceptually sound, organisationally practical, and politically sensitive helps reach this end.

Professional development and assistance: Professional development, the most critical of all factors affecting implementation, pays handsome dividends in terms of increased commitment and practice mastery of users. The scope of participation in training determines the diffusion rate of the innovation. To provide implementors with strong educational and emotional support, professional development has to demonstrate continuity, a variety of learning partners and learning formats as well as opportunities for practice and feedback.

Implementation monitoring and problem solving: Rapid change in technology generates the need for careful monitoring. Information collected through research on what is happening, what is working and what is not, builds knowledge about best practices, and facilitates on-going modification.

Principal's leadership: For the success of school-based change, school principals need to be knowledgeable on the innovations they try out. They also have to create a positive climate for change by arranging for initial training and follow-up, user interaction, accountability and rewards.

Community support: Active parental support requires the public to be educated on innovation benefits. Involving parents in computer committees, and use of print media, demonstrations and presentations help expand the communication effort.

Environmental stability: Environmental instability can bring about discontinuity in funds, product uncertainty and high turnover in key personnel. Negative effects of staffing changes, however, can be minimised by diversifying expertise and entrusting responsibility for implementation management in various positions.

Administrative Computing

Efficiency and effectiveness, according to Visscher (1988), are two important concepts in administration. Efficiency denotes the relation between the input (manpower, facilities), and the output (production) of a process. Effectiveness is the degree to which the goals of an organisation are achieved. Computers improve efficiency of the educational bureaucracy mostly in the clerical area, where activities are well structured and easy to computerize. As Friend (1988) noted, they influence the effectiveness of organisations by contributing to better decisions and making feasible many tasks that previously were unfeasible.

Kaul (1987) related the impact of information technology to both short- and long-term benefits derived from its use. The short-term benefits, related mostly to efficiency, include reduced costs in terms of better allocation and utilization of resources, more services to the public, and improved revenues. The long-term benefits, contributing mostly to effectiveness, include improvements in the skill base and the working conditions of staff, and the information culture generated through better information and rational processes.

Computers, according to Spuck and Atkinson (1983), when properly used permit economies in time ordinarily consumed in routine tasks. The judicious use of a single microcomputer, according to Bluhm (1987), could save up to 200 hours, or the equivalent of 25 eight-hour days in a school year. Computerization allows administrators more time to think about structures and procedures that are already in use. Any type of organisation can benefit from computerisation when their members begin to translate these new mental structures into their professional work.

Computers, according to Stewart (1971), integrate planning processes, and increase the interdependence among different departments. Moreover, they enable a wider search for new problems and alternatives and provide better opportunities for quick and frequent reviews. As Brodman (1986) indicated, computers also facilitate rational allocation of resources toward goals of efficiency and equity. The conflict between the technocratic pull to allocate resources efficiently, and the bureaucratic pull to respond to other considerations such as political pressures and personal gains, however, may limit the potential of the computer in allocation decisions.

Computers generate a positive influence on labour quality by reducing the drudgery of the work day for clerical staff. Visscher (1988) saw this improvement in terms of varied and interesting job content, decreased labour times, improved salary positions, and healthy operating environments that enable better relations with peers, superiors and subordinates. Computers also make the work of managers easier, less tedious and more interesting, and provide an incentive to them as well.

Computers today serve many roles, and are hardly dedicated to just one function. Kiely (1980), as cited in Alvarez, Simley and Rohrmann (1985), defined office automation as the application of computer technology to the office to solve the problem of too many people doing too little for too much. Office automation compensates for low levels of training in routine tasks. This allows not only the repetitive work of an organisation to be performed more effectively, but also the personnel previously engaged in this to be utilized more productively.

Decision Support Systems (DSS) provide a wide range of tools for the end-user manager. They replace simple deterministic techniques of the past by far more effective, probabilistic methods, and assist managers in unstructured decisions where algorithms cannot be specified for at least one of the three phases (intelligence, design and choice) of the decision making process. DSSs, according to Keen and Scott Mortan (1978), support management judgement by extending the bounded rationality of managers. More advanced systems that use technologies of artificial intelligence to solve practical problems, enable richer insights and in-depth understanding of situations.

Wordprocessing is a technique which makes the preparation and revision of long manuscripts less cumbersome and quicker, with substantial improvements in the quality of the final product. This, according to the UN (1985), increases the productivity of secretarial work by more than 30 percent. As Huntington (1983) noted, a computer used for nothing other than for wordprocessing still pays for itself in a very short time. Mail merging, an important feature of wordprocessing, according to Hurst (1987), allows standard letters to be printed for each individual addressee, with specific information incorporated as suitable.

No program or reform, according to Zanuttini (1982), can be planned in the absence of relevant information based on reliable data. Management Information Systems (MIS) that obtain, store, manipulate, and retrieve data needed for decision making

(Johnson & David, 1990), serve a useful purpose here. These systems, according to Zanuttini (1982), help managers in a dynamic society to keep pace with increasing and changing demands. They also reduce the drudgery of long calculations and assist efficient processing of large amounts of information.

Computerized information systems improve the decision maker's access to useful and timely information which illuminates issues, facilitates discussion, and according to Wilson (1990) saves organisations from information poverty. As Brodman (1985) noted, such systems are also flexible in responding to user needs. The customized, simple reports they make possible, help decision makers respond quickly to various information requests. The data processed by computers also appear more credible in the eyes of the layman, and facilitates accountability.

Johnson and David (1990) recognized MIS as a means to better use of resources as well as to reduced costs. Such systems, when computerized, not only save staff time in filing and retrieving information, but also create a marked reduction of paper in the system. The smaller storage space needed in the latter situation, enables information to be kept for longer periods of time. Further, when integrated with other systems, the MIS enables direct transfer of data from one program to another. This, in addition to saving time and effort, helps develop uniformity across departments with regard to methods of data collection and utilization.

Computerized systems, according to Ogilvie (1981) not only deal with more information of better quality, but also send it further, faster, and with greater fidelity. As

Akindale (1989) noted, the prompt dissemination of vital information among planners and researchers helps determine trends, formulate forecasts, and assess alternatives. According to Wilson (1977), fast, dependable and comprehensive feedback made available on a system's operations facilitates monitoring.

Developments in electronic communications have dramatically changed human society. Azarmsa (1991) defined telecommunications as a process of transmitting information over a distance by an electrical or electromagnetic system. Data communication, according to Azarmsa (1991), is the transmission of data from one computer to another computer in some other location. Computers that are located close to each other either in the same room or in the same building, communicate data through direct cable link. Computers located far apart use transmission facilities such as telephone lines or satellites for the same purpose.

There are two basic combinations of data communication. In a micro-to-mainframe link, micro computers are connected to a large host computer to share data and computing power. A Local Area Network (LAN), on the other hand, consists of a number of computers wired together to provide communications within a limited geographical area. Communication in the former type of configuration is mostly via modem and telephone lines. A modem is a device that converts digital signals produced by a computer into analog signals that telephone lines can transmit. Once the transmission is over, the modem reconverts the analog signal into a digital signal so that it can be used by the receiving computer.

Networking helps share software and peripherals, reduces the error rate of data transmission, and significantly lowers the cost of data communications. Sharing of software eliminates the need to produce multiple copies of software. This according to Johnson and David (1990), reduces not only the cost, but the associated legal liability as well.

Policy and Policy Formulation

Pal (1987) defined policy as a course of action or inaction chosen by authorities to address a given problem or an inter-related set of problems. Gathercoal (1991) described policy as general decisions that serve as rules, precedents or guidelines for future decisions. According to Weiss (1976) policies are not made at a single point in time, but happen as a result of gradual accretions. Pal (1987) also saw policy as an accumulation of decisions over time. Thus, broader than a decision, policy connotes a plan, a coherent vision, a direction or a resolve to get on with a job.

Bauer (1968) used the breadth of implications to differentiate policy from routine and tactical decisions. Routine decisions according to Bauer, are trivial and repetitive. Tactical decisions that demand more thought are complex and have wider ramifications. Bauer (1968) reserved the term policy for those decisions that have the widest ramifications, the largest time perspective, and that require the most information and contemplation.

Governance in education serves two major obligations. On the one hand, it processes values, needs and demands of the society to determine which of these are to be accepted as the official guidelines for the system of education. On the other hand, it sets guidelines to provide direction for the operation of schools. Taking both of these into consideration, Downey (1988) defined policy as an instrument of governance at the local level. Figure 1 depicts this view of policy.

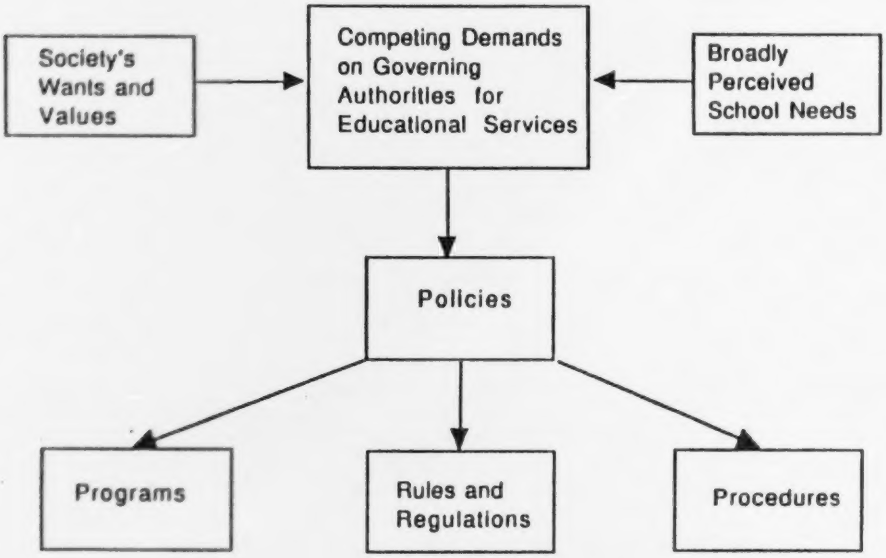
Society's Wants and Values
Competing Demands on Governing Authorities for Educational Services
Broadly Perceived School Needs
Policies
Programs
Rules and Regulations
Procedures

Figure 1

The Role of Policy in Governance

(Adapted from Downey,1988, p.11)

Guba (1984) identified three policy types which he referred to as policy-in-intention, policy-in-action and policy-in-experience. Three categories of personnel - the top level authorities, the operational implementers and the clients - determine these policy types. Guba (1984) found the definition of policy assumed by the policy analyst to be of considerable importance since this deals with the type of policy questions raised, the kinds of policy-relevant data gathered, the sources of data tapped, the methodology used, and the policy outputs produced.

Policies in education are found at all levels of the system, namely federal, state/provincial, district and school. The level of the organisation is, therefore, critical in deciding what is policy. A directive issued at a higher level provides the general framework for those at a lower level to arrive at tactical decisions. The directive at the higher level thus becomes policy for those at the lower level, while tactical decisions made at the lower level become policy for those at still lower levels. Thus, according to Bauer (1968), the perspective of the individual viewing the event determines policy.

The empirical content of any policy incorporates three elements. Pal (1987) identified these as the problem definition, the goals and the instruments. The definition of the problem, which constitutes the why of the policy, acts as the key to deciphering the meaning and logic of the policy. The goals reveal the central problems addressed by the policy, while the instruments provide the means for achieving the goals. Policies, according to Pal (1987), usually constitute a cluster of problems, a number of goals and one or more instruments. White and Rampy (1983) defined policy issues as complex concerns about which decisions must be made. Such issues lead to planning and action. May (1981) defined policy alternatives as tentative hypotheses on courses of action that address a given set of conditions of a policy problem for the achievement of a better set of conditions.

Downey (1988) identified two positions in policy making neither of which on its own is tenable. One, operating entirely on the will-of-the-people, determines the winners on the basis of power and influence. The other opts entirely for the will-of-the-experts who also have their own biases, preferences and prejudices. For smooth functioning, the policy making processes require the best available analyses and advice as well as related political inputs.

Downey (1988) considered policy making as legitimation of expertise. This view, wherein the professional expertise of the executive plays an important role, is not retrospective because past actions do not necessarily become bases for future policies. It is not reactive either, because policy initiatives result only through a thorough processing of needs by somebody with expertise. Although characterised as bureaucratic, and challenged as unresponsive to the community, the involvement of the informed can result in a set of policies which are well above mediocre.

Nagel (1984), introduced two types of policy studies. The first type regards policy as given and focuses on determining the effects of policy. The second type identifies the goals, and then considering them as given, attempts to arrive at policies that maximise the goals. In a similar vein, Holdaway (1986) distinguished between "studies of policy," and "studies for policy." The first category according to him, is less problematic when compared to the second, which is somewhat controversial. Many analyses according to May (1981), are evaluations of already specified policy alternatives, and it is only occasionally that policy researchers set out to generate their own data or assume responsibility for inventing novel policy ideas.

Policy models according to Dye (1981), should address the substance of the policy in terms of who gets what and why as well as the processes by which policy is developed, implemented and changed. Dye also saw a distinct relationship between the way in which policies are made and the content of the emerging policy. This relationship denotes the importance of the policy approach in improving the quality of policy decisions.

Dunn (1981) described a policy model consisting of six types of policy-relevant information components and six types of policy-analytic methods. The policy-relevant information in this model consist of antecedents, policy problems, policy alternatives, policy actions, policy outcomes and policy performance. The policy-analytic methods that transform these policy-relevant information components include problem structuring, forecasting, recommendation, monitoring, evaluation, and practical inference.

As Bauer (1968) noted, the policy maker has to identify issues, propose alternative solutions, and balance each alternative against a wide range of other alternatives paying reasonable concern to unforeseen events. Although a variety of experiences from a number of places can be of use here, limitations in place units, according to Nagel (1984), hinder effective policy research. The possibility of analyzing several time points of the same place unit, however, can offset this problem.

Policies should meet at least the minimal objectives of those formulating them while simultaneously generating the needed support from the stakeholders. According to Dunn (1981, p.47), stakeholders are "individuals or groups who have a stake in problems because they affect and are affected by government decisions." To obtain the support of such persons, Bauer (1968) found that the policy maker needs to mediate among conflicting sets of values and interests.

Generation of defensible policy informing data (intelligence) is the essence of policy analysis (Downey, 1988). According to Nagel (1984), policy analysts have an obligation to be concerned with recommending policies that are efficient in keeping costs down, as well as effective in achieving benefits. Pre-adoption evaluation, required here, is more difficult and risky than any evaluation conducted to assess the effectiveness of an already implemented policy action.

Research, according to Weiss (1976) ought to fulfil the demands of the political environment. In the first place, it should focus on variables that policymakers can manipulate with minimal destruction to existing social arrangements. The researcher also must communicate to the policymaker what was done, what was found, and what it all means in a language that the policymaker can follow. Jargon, which often makes research reports unintelligible to the policymaker, should be avoided.

Figure 2 illustrates the transformation cycle among policy, strategy and operational plan as indicated by Hammer and Loucks-Horsley (1985). According to this model, a policy aim guides the development of a strategy, which in turn frames the operational plan. Implementation of the operational plan provides information which has effects on the policy. A strategy, to be worthwhile, has to fulfil a multitude of requirements. As Fullan, Miles and Anderson (1988) indicated, it should respect the local condition, account for uncertainties, accommodate both present and potential users, reduce user overload, support user interaction, channel the strengths of existing human resources, and create some early success.

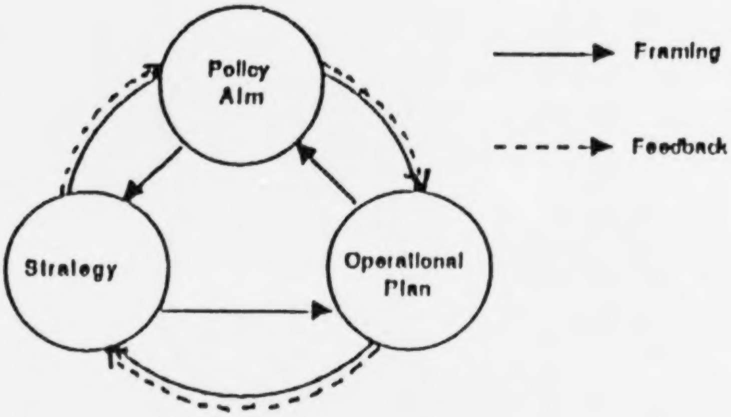

Figure 2

Transformation Cycle Among Policy, Strategy and Operational Plan

(Adapted from Hammer and Loucks-Horsley, 1985)

The Conceptual Framework

A particular concept of policy and a particular model of the policy making process together provide the conceptual framework for a policy study. This study considers policy as an instrument of governance. Such instruments incorporate both authoritative choices from among society's competing needs, and guidelines to direct school operations. The model of policy making that guides this inquiry is adapted from Dunn (1981). This model indicates how six types of policy-analytic methods assist in the transformation of six types of policy-relevant information.

The policy formulation process conducted in this study focused primarily on expertise and accumulated wisdom. Attention was paid to the work of others to capitalise on what they have done. This reliance on experiential knowledge is mainly to generate defensible policy informing data. Figure 3 denotes the conceptual framework developed for this study. The topmost rectangle of the framework denotes the model adapted from Dunn (1981).

Data needs for this study focused on the A, B, C, D, E and F components indicated in Figure 3. Policy problems encountered by others elsewhere and the antecedent conditions that led to these problems were the first sets of data to be collected. Data were also collected on the policy alternatives forecasted, policy actions recommended, policy outcomes monitored, and the policy performance inferred. Policy formulation for the study rested on the analysis of the data so collected. This process followed the A-B-C-D-G-C path indicated in Figure 3, with focus on the education system of Sri Lanka in general and the national schools in particular.

The above conceptualisation approached the problem in two ways: first as a study of policy, and second as a study for policy. The computing and policy practices of other countries that are substantially more advanced in educational computing had to be studied first to analyze the policies already in use. The knowledge so gained was utilised later to establish goals for the type of schools selected, and to arrive at a set of policy guidelines that contributed to the attainment of these goals.

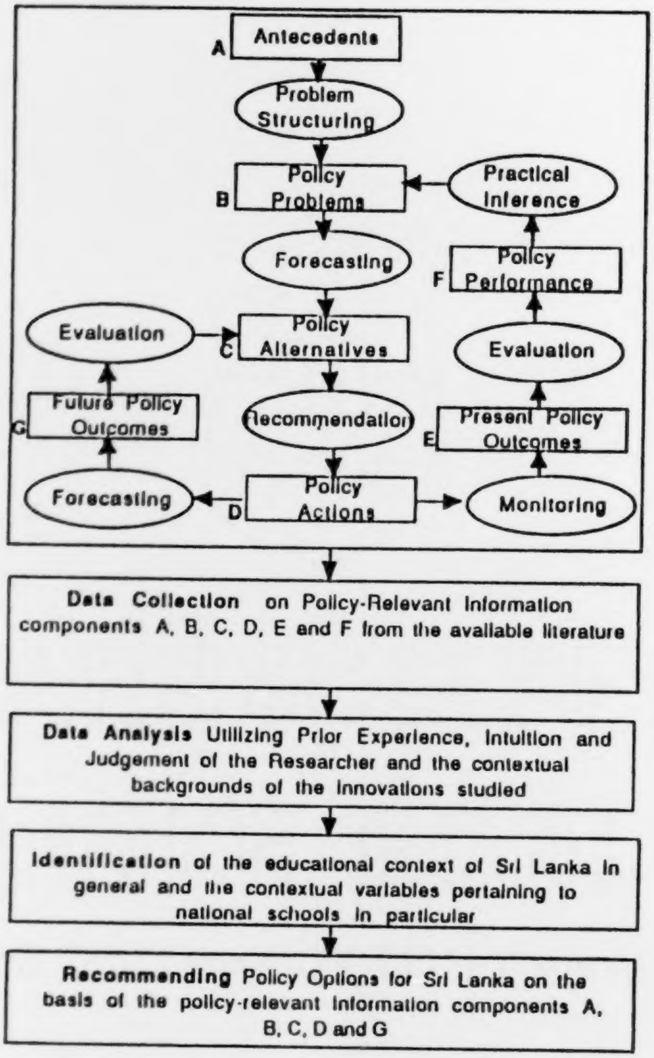
A
Antecedents
Problem Structuring
B
Policy Problems
Practical Inference
Forecasting
F
Policy Performance
Evaluation
C
Policy Alternatives
Evaluation
G
Future Policy Outcomes
Recommendation
E
Present Policy Outcomes
Forecasting
D
Policy Actions
Monitoring
Data Collection on Policy-Relevant Information components A, B, C, D, E and F from the available literature
Data Analysis Utilizing Prior Experience, Intuition and Judgement of the Researcher and the contextual backgrounds of the innovations studied
Identification of the educational context of Sri Lanka in general and the contextual variables pertaining to national schools in particular
Recommending Policy Options for Sri Lanka on the basis of the policy-relevant information components A, B, C, D and G

Figure 3

The Conceptual Framework

Summary

Change, when properly planned and managed, helps schools accomplish their goals more effectively. A change that replaces manual methods of school administration by computerized methods, can improve the efficiency, effectiveness, and the work quality of organisations. Such change also can improve information management, enable better decision support to mangers, facilitate wordprocessing, and pave the way for electronic communications. Policy provides direction for the schools implementing the change. The policy process recommended for this study involves primarily reviewing antecedents, structuring policy problems, forecasting policy alternatives, and recommending policy action.

Chapter 3

Methodological Framework

Research Methodology

The purpose of this study was to formulate a policy for the implementation of administrative computing in the national schools of Sri Lanka. To be successful in this endeavour, one has to understand current computing practices of schools, how the practices originated and developed over time, issues in the area of educational computing, strategies adopted to resolve these issues, and the policies that have guided action. According to McMillan and Schumacher (1989), knowledge and understanding about past educational ideas, events, legal principles and policy making enhance insights into current educational events. Analytical research that describes and interprets the past from available sources, therefore, provides a suitable methodology for this study.

McMillan and Schumacher (1989) described analytical research as an unobtrusive method where the researchers neither directly observe, measure, or experiment with current educational phenomena, nor attempt to test their findings statistically. Instead, the researchers use logical induction to analyze, qualitatively, traces of the past, which in this case are documents preserved in collections. The specification of details in terms of the who, what, when, where and how of an event as well as interpretation as to why that event occurred are the main features of the analytical explanation that differentiates it from the statistical explanation.

The analytical design used in this study involves some elements of historical and philosophical inquiry. According to Carlson (1981), as cited in Merriam and Simpson (1984), these are the most effective methodologies for understanding practice. As Merriam and Simpson (1984, p. 78) noted, "historical inquiry goes back to the past events and people - the early building blocks of a field - to illuminate present practice." This type of inquiry examines failures and great feats in a field, the impact of the practice, and the total context within which it occurred. According to Merriam and Simpson (1984), historical inquiry offers clues to possible rather than probable behaviour, and allows one to anticipate rather than to predict and to take precautions rather than to control. Philosophical inquiry, on the other hand, examines the underlying opinions, beliefs, values, and assumptions of events to bring clarity to the practice under concern. On the whole, the analytical design provides the perspective that lets the analysts determine where they have come from, what they are doing and why, where they appear to be going, and how they might influence the future for better results.

Data Requirements and Sources of Data

The success of any inquiry depends on the amount of information available, its quality, relevance, and clarity. To be in line with these requirements data have to be selected with discrimination, separating the important from the trivial and the relevant from the irrelevant.

Documents, the only source of information for this study, were of different types (primary/secondary, official/ unofficial, public/private, and published/unpublished), and in numerous forms (books, journal articles, case studies, research reports, seminar/workshop reports, evaluation reports, financial reports, statistical reports, and theses). Historical documents such as policy papers, administrative records, court records, and minutes of relevant meetings also helped meet the data needs of the study.

The study required two types of information for its successful completion. Data internal to the country under concern, the first of these, came largely from publications produced by computing and educational authorities of Sri Lanka as well as from international agencies that have provided advocacy in the area of computing. These publications provided the researcher three major types of information: the inception, evolution, and the present status of computing in the country; the development of computing in education; and specific information on the governance, organisation, staffing patterns, needs, and issues of the national schools that provide the context for this particular innovation.

The other type of data collected was external to the country under concern, and dealt largely with experiences of other countries well ahead in computing. These data incorporated five major themes, namely, important concepts in the area identified for research, ideas that help justify the need for computers in developing countries, the role of the computer in school administration, policy-relevant information (antecedents, policy problems, policy alternatives, policy action, policy outcomes, policy performance), and policies that have guided action in technology-related innovations. All this information, together with related personal experiences of the researcher helped meet the data requirements of the study.

Data Collection

Data collection for this study focused on eight major themes deduced on the basis of the research questions. Document analysis was the technique used to collect these data. As a preliminary step in conducting this analysis, the problem statement was reviewed carefully to establish criteria for the selection of sources. Next, computer searches were conducted on a number of databases such as ERIC, IDRC and UNESCO to locate the related literature. Guides, catalogues, indexes, and publication lists also assisted in this endeavour. The Dissertation Abstract International helped locate relevant theses. The Social Science Citation Index brought to light publications of frequently quoted authors. Bibliographies of recent publications enabled insights into other suitable sources.

All documents located were analyzed in terms of the substance covered. This enabled the researcher to produce several lists of documents that matched different data requirements of the study. When the content of a particular document matched more than one theme identified for data collection, the name of that document was included in all relevant lists. Out of these lists a manageable number of documents was identified for review considering factors such as accessibility and recency of documents, relevance of material to the study phenomena, and quality of presentation.

The documents selected were read in detail to obtain descriptive facts such as the who, what, when, where and how of the major events. The data, so gathered, were judged on the basis of consistency and accumulation of evidence. Moreover, the researcher tried to be sceptical and critical of the statements throughout data collection. An attempt was also made to search for consistent trends, unique situations, and new directions.

Data Organisation and Analysis

The data, collected in the form of written documents, are not amenable to analysis until the information is condensed and made comparable. This study used content analysis for this purpose. Berg (1984) described content analysis as "a technique for making inferences by systematic and objective identification of special characteristics of messages" (p. 106). An objective analysis of messages is usually accomplished by means of explicit rules of selection. Establishment of criteria prior to actual data analysis and applying these consistently throughout the content selection process eliminate researcher bias in deciding which data are to be included in the analysis. This approach, which analyses the data on the basis of a suitable categorical scheme, was deductive in nature. The inductive approach also played a prominent role in content analysis. This approach, tied mainly to grounded theory rather than to established theory, used messages themselves to identify meaningful themes or dimensions.

As a first step in applying the technique of content analysis to this particular study, the major themes identified for data collection were assigned numerical codes. The documents located for each theme were read carefully keeping the themes in mind. Whenever an idea that matched any one of the themes appeared, the code given to the theme was marked on the left margin of the document. The computer was used to open five files and to record all key ideas pertaining to the themes in relevant files. Both quantitative and qualitative attributes of the text gained consideration in this effort.

The above process resulted in five major narratives. These were read carefully later to arrive at a set of concepts and theoretical categories. The inductive approach played a prominent role in determining categories that matched the data.

The coding process conducted in this study was of two types. Open or unrestricted coding, the first of these, opened the inquiry widely. Since more is thought better at the beginning, an attempt was made to identify as many categories as possible during the early stages of coding. Open coding was continued up to a point where the document became saturated with repetitious codes that enabled the researcher to move rapidly through the documents. Axial coding that followed is a kind of sorting that consists of systematic and intensive coding around the categories previously selected. This type of coding helped the researcher further elaborate the theoretical categories revealed by open coding. A coding scheme was developed to label the subcategories so identified. This scheme incorporated a system of cross-referencing to identify material that was relevant to more than one category.

A number of policy-analytic methods helped analyze the policy-relevant data. These methods took a variety of forms depending on the stage of the policy process. In the "initiation" stage, an attempt was made to review existing policies and practices in terms of their timeliness, quality, moral acceptability, and implementability. This brought to light a number of issues that need to be addressed. In the second stage of "creation," speculative thought on the part of the researcher helped generate alternative solutions for the above issues, craft them into a form that render them testable, and to pack them in a comparable way for better understanding and subsequent tests of viability. All this called for intuitive ways of knowing, which according to Downey (1988), requires creative thought in the unreal, yet-to-be world of probabilities and anticipations. In the "evaluation" stage of the policy process, an attempt was made to estimate the strengths and weaknesses of these alternatives paying particular attention to trade-offs between their pros and cons. One objective was to identify a solution for each issue that could be implemented cost-effectively. The attractiveness of the alternatives in the political arena; their potential for unintended consequences; fidelity with existing values, goals, and other policies; and their compatibility with societal norms were some other factors considered. In the final stage of "choice," the techniques of data synthesis and display were used to assemble, order, and present the results of the above analysis to facilitate informed choice.

Interpretation of Data

Merriam and Simpson (1984) defined interpretation as the task of bringing insight and coherence to a set of facts. The task of the researcher in this process is to extract some meaning out of the data analyzed and presented, or impose some philosophy upon it. As a first step in interpretation, the researcher has to arrive at generalizations by the application of inductive logic and critical judgement. In arriving at generalizations, the researcher also has to shed "present mindedness" which Merriam and Simpson (1984) described as the instinctive habit of looking at the data through one's own eyes rather than from the point of view of the participants. As McMillan and Schumacher (1989) indicated, the interpretation process takes a cyclic nature. This requires the researcher to return to facts constantly, and when necessary to documents to derive the meaning. Generalizations established in the above manner, were synthesized later to arrive at a number of "what should be" positions. The scholarly experience of the researcher with the study phenomena assisted in deriving the needed insights. The personal experience of the researcher with the contextual factors helped these insights to be transferred appropriately to the country under concern.

Concerns About Trustworthiness

A rationalistic or quantitative study is expected to meet the criteria of internal validity, external validity, reliability and objectivity. Guba and Lincoln (1981) argued that the criterion of trustworthiness is more appropriate for the naturalistic paradigm. For a study to be considered trustworthy, it must meet proper standards of credibility, transferability, dependability, and confirmability.

The truth value or credibility of a study, according to McMillan and Schumacher (1989), refers to the truth or falsity of the propositions it generates. In other words, this indicates the degree to which the explanations of phenomena match the realities of the world. Guba and Lincoln (1981) suggested structural corroboration as a means for increasing credibility. This is a process where the data gathered are used to establish links that eventually create a whole. Guba and Lincoln identified triangulation as one method for establishing structural corroboration. Denzin (1978, p.297) defined triangulation as "a combination of methodologies in the study of the same phenomena."

According to Denzin, four different modes, namely sources, methods, investigators and theories enable triangulation. This study achieved triangulation by searching several archives, and obtaining data from a variety of sources and several perspectives. The credibility of the study increased when the data, so collected, provided similar points of view, or gave a similar picture of what is happening. Heavy reliance was also placed on induction to make the explanations match the realities of the world.

Transferability, according to McMillan and Schumacher (1989), is the extent to which the conclusions of a study can be generalized to other people and settings. Since the data collected in a naturalistic study are not a single small part, but rather a complex description of events, generalizations to situations completely outside the study may not always be possible. The context specific nature of many practices also hinder transferability in qualitative research. Differences always can occur when the new situation does not fit the characteristics of the setting for which the study was intended. Since a complete picture of the context gives the reader a feeling for the situation of the study and increases its transferability, the researcher made special attempts to describe the social, political, cultural economic and technological conditions of developing countries, and the educational organisation of the country under concern.

Reliability in the rationalistic paradigm refers to the extent to which independent researchers discover the same phenomena under the same or similar situations. Since a naturalistic study cannot be reproduced in as much detail, the term "dependability" is used. The dependability of a study relies on the consistency of the styles adopted by researchers in data recording, analysis and interpretation. To assure consistency of methods, a need exists to provide the reader with a detailed description of the steps taken during the study. The dependability of this study was strengthened by making known the important decisions made by the researcher at different stages of the process along with the reasoning that accompanied these decisions. More specifically, the conceptual framework of the study and all sources of data that assisted its completion are made explicit along with how data were recorded and synthesized, and the strategies adopted for data analysis and interpretation.

In any study, the bias of the researcher must not cloud the data or their interpretation. The objectivity of an inquiry, according to Guba and Lincoln (1981), is the degree to which the study findings become a function solely of the subjects and the conditions studied, rather than of the biases, motives, interests, perspectives or competence of the inquirer. Many difficulties associated with eliminating researcher bias make confirmability of information more important than improving the objectivity of the inquirer. Since the researcher in this type of research is directly involved in all decisions and judgements, it is particularly difficult to maintain an unbiased point of view. In order to maintain confirmability, the data collected in this study were judged on the basis of consistency and accumulation of evidence. Conscious effort was also made to present all arguments largely on evidence and as little as possible on the values and philosophy of the researcher, and to use objective methods at least in the preliminary stages of data analysis.

Ethical Considerations

The study conducted was unobtrusive in nature. The archival data it used constitute a non-interactive technique for data collection. In using archives, Berg (1989) illustrated the need to ensure confidentiality and to protect the privacy of all involved. This requires steps to be taken to avoid the identification of individuals or institutions depicted in the reports. Ethical considerations, however, are needed only when archives include identifiers such as names, addresses, occupations, charges and the like, and when particulars of identity are required for the successful completion of the study. Since the study demanded little in terms of the latter, an attempt was made to remove all sensitive identifiers and to aggregate the data according to some non-identifying factor.

Summary

Analytical research that describes and interprets the past from available sources was the method selected for this study. Data collected through different types of documents enlightened the researcher on the antecedents, implementation, and the impact of similar innovations as well as on the educational and computing set-up of the country under concern. Content analysis was used to condense the data and to bring it to a form amenable to analysis. The deductive approach played an important role in deciding the major themes for data analysis, while the inductive approach helped determine the needed theoretical categories. Policy analytic methods also played a role in data analysis. The data so collected and analyzed were interpreted to arrive at causal explanations and "what should be" positions. To strengthen the trustworthiness of the study attempts were made to collect data from a variety of sources, describe in detail the context for which the policy is intended, make explicit the styles adopted for data recording, analysis and interpretation, and to judge the data collected on the basis of consistency and accumulation of evidence.

Chapter 4

Educational Computing in Sri Lanka

Introduction

The purpose of this chapter is to explain the present status of educational computing in Sri Lanka with particular reference to policy. As a first step here, the need for computers in developing countries is examined to provide a sound rationale for the introduction of computers to the country. Some important policy initiatives at the national level are then discussed to highlight how computer technology originated and developed in Sri Lanka. Next, the school system of the country is illustrated in terms of its composition and governance. Finally, various trends in educational computing are elaborated, and the current status of computing in the Sri Lankan general education context is explained.

The Need for Computers in Developing Countries

Rapid advancements in information technology, according to Brodman (1986), have provided means for developing countries to leapfrog into the modern world of today, and to engender unprecedented development through improvements in management efficiency and effectiveness. Nevertheless, the use of computers in such settings raises a myriad of questions and contentions because most developing countries:

> are mainly rural,
> are short of capital,
> are short of foreign exchange,
> are short of skilled manpower, and,
> have a surplus of unskilled labour.
>
> Gupta (1987, p.43)

According to Alvarez, Simley and Rohrmann (1985), many people in developing countries view attempts to keep up with advancements in technology as an unnecessary expenditure of foreign currency. New technology is believed to increase poverty, internal disparity and cultural dependence of these countries, and to widen the existing economic gap with the developed world. Some consider technology as a contributor to increased unemployment and question its suitability for countries that enjoy the benefit of cheap labour. Others argue computers are too sophisticated, inappropriate and concentrate power in central authorities.

The large rural populations of developing countries often do not benefit from computer technology due to inadequate infrastructure and skilled manpower. In spite of the continuing reduction in hardware costs, a case can be made therefore, that computer technology is not appropriate for developing countries, and that it is not worthwhile to use the scarce resources of these countries in a direction which does not meet the needs of the majority. Gupta (1987) identified this as an extremely persuasive argument, which however, may not be valid. According to Hurley (1988), change does not always assure progress, but progress implacably requires change. This makes the shape of the computing environment a major factor in projecting the developing countries to the next tier of development.

Developing countries, according to Brodman (1986), are burdened with numerous macro economic challenges such as labour-heavy factor proportions and declining trade revenues. As Nag (1988) noted, this does not allow these countries to acquire computers merely to appear modern. The need for computers in developing countries has to be assessed in their broader social, economic, political and cultural context, and also in the availability of necessary prerequisites such as electricity and telecommunications.

Wilson (1990) identified funding as a barrier for this innovation. Nevertheless, trends in hardware and software costs over the past few years have caused a significant change in the economics of computerization. Computer systems today cost less than mechanical or electrical alternatives. In developed countries these even cost less than manual systems. With rising labour costs, the above cost advantage will be soon prominent in developing countries as well.

The political environments in many developing countries are unstable. This prohibits both long-range goals and leadership continuity, and prevents the adoption of phased-in strategies that are essential, particularly under strained economic conditions. The low education level of the populace in most of these countries also retards the extent of support, interest and commitment the innovation could possibly obtain.

According to Oettinger (1980), "every society is an information society, and every organization is an information organization" (p. 193). With national economies throughout the world becoming increasingly information-based, the production and consumption of information has become a principal source for international understanding and future prosperity. In spite of this knowledge, the typical literate person in most developing countries still hesitates to consider information as a resource of any particular value. This, according to Kerr (1990), is a major cultural barrier to computing. People in non-technological societies also have had little or no opportunity to deal with sophisticated equipment. This makes them demonstrate high anxiety when compelled to do so. More and more use of technology, according to Brodman (1986), can generate a trend that recognizes the value of information resources and overcome the problem of anxiety.

One of the major concerns about modern technology relates to its anticipated negative effect on employment. Long-term experiences of developed countries, however, are contrary to this. The use of computers makes a positive contribution to employment, directly through posts available in computer installations themselves, and indirectly through the opportunities opened up by increased productivity. According to the UNDP/ILO (1982), computers lead to loss of employment only when they are used for work which manual methods can effectively handle and become appropriate even in labour intensive economies.

As Nice (1987) indicated, the power of a nation comes mostly from the technological competence of its people rather than from its natural resources. To reduce dependence on the developed countries, and to safeguard the labour wage competitiveness in the world economy, which according to Harsh and Weber (1985) becomes evident as the industrialized nations embrace new technology, the developing countries have no alternative other than to reorder their national priorities.

Computers are increasingly robust today and last remarkably well even under the conditions of erratic power supply, high humidity, heat, and dust that are prevalent in developing countries. As Munasinghe, Dow and Fritz (1985) noted, spectacular reductions in cost, size, and power requirements as well as equally startling improvements in speed, computing capacity, memory size and reliability provide a bright future for wider use of computers. Recent developments in technology have also made computers easier to learn and adopt. Moreover, the increased reliability they demonstrate enable their use in many applications with only a small risk of failure. Manual systems in contrast tend to be less accurate and efficient, particularly in developing countries where routine monotonous work, low salaries, and inappropriate promotional schemes have demotivated and demoralized the large workforces.

New technology is an integral part of the everyday environment of industrialized societies. The medium for international exchange of information is also becoming increasingly computer-based. Thus, "what some people once referred to as just another bandwagon has turned into a high speed locomotive" (Marshall, 1984, p. 377). If the computer lives up only to a fraction of its espoused potential, then the less industrialized, developing nations that hesitate to utilize computers are sure to be left behind, widening the gap between the developed and the developing nations.

Considering the new surge of interest in the use of computers and the clear advantage of introducing these in the developing world, the government of Sri Lanka in the early 1980's took a number of policy initiatives to become part of the information age. The next section outlines these initiatives.

Computer Policy Initiatives in Sri Lanka

When compared to many other countries in the third world, Sri Lanka was somewhat late in adopting modern equipment of the electronic revolution. The extremely restrictive commercial policy practised previous to the year 1977 did not allow the country any access to modern information technologies, particularly to hardware imports. With the adoption of a free trade policy in 1977, the situation changed drastically, and the products of the electronic revolution began to penetrate both commerce and industry.

The Computer Society of Sri Lanka (CSSL), was established in 1977 to popularize the profession and to create computer awareness among political circles (UNESCO, 1986). In order to systematize the acquisition and use of computers in the country, the government of Sri Lanka in late 1982 appointed a committee to formulate a national policy on informatics. Recommendations of this committee led to the creation of the Computer and Information Technology Council (CINTEC) in the year 1984.

CINTEC, with a role of stimulation rather than regulation, is the prime organisation responsible for the formulation and implementation of national policy in technology. The Ministry of Education and the Ministry of Higher Education undertake responsibility respectively for two of the Council's major concerns, the development of computer literacy at school level and equipping of higher educational institutions with modern equipment. The Sri Lanka Inter University Computing Committee (SLIUCC) is the main co-ordinator in all these endeavours.

Even with such efforts, the year 1986 saw only a total of about 1000 microcomputers, and 100 mini and mainframe computers restricted to urban areas of the country. The microcomputers were used largely by schools and offices, while the mini and mainframe computers were confined to large firms in both the public and the private sector. To provide firm ground for the discussion of computer policy initiatives in general education, the next section describes the school system of Sri Lanka both in terms of composition and governance.

The School System of Sri Lanka

Original Composition.
The general education system of Sri Lanka in the early 1980s consisted of about 9500 schools, classified as type 1, type 2 and type 3. Type 3 schools were primary schools with classes from grade 1 to grade 5. Type 2 schools had classes up to grade 8 or grade 10. Type 1 schools with classes up to grade 12 were again subdivided into two categories, depending on the availability of the science stream at the senior secondary level.

Recent Developments.
The above schools, although sufficiently dispersed to provide schooling within every child's neighbourhood, demonstrated major disparities with respect to educational standards. Further, they functioned as individual units, competing for the limited resources of the state, and the patronage of wealthy parents. As a result, a few large schools enriched themselves at the expense of many small and poor schools. To reduce this resource imbalance, the Educational Proposals for Reform (1981) recommended a new system that comprised national and cluster schools.

The national schools, few in number, are large, prestigious schools with a student enrolment between 3000 and 6000. These schools located in the urban areas of the country gain acceptance for the high academic standards they maintain. National schools that depend on state aid only for teacher salaries and capital expenditures, mobilize resources from their school communities and manage most of their own affairs. Thus, they are largely self-reliant, and enjoy a great degree of autonomy.

One problem is that national schools are not evenly distributed across the country. This further deprives the educationally under developed regions. To provide a more representative group of national schools for the nation, the Ministry of Education is currently in the process of developing the human and physical resources as well as the educational standards of a few other schools in the country, with the objective of upgrading them to the status of national schools.

Except for a few isolated schools in remote areas, and a very small number of private schools outside the state system, the remaining schools in the country are grouped into clusters for the purpose of better organization, management and development. A school cluster comprises of 10 to 15 primary and secondary schools located in a defined geographical area commonly known as a zone. Each cluster, with a total pupil population of 2,000 to 10,000 and a teacher population of 100 to 400, is organised around one large school in the group that is also rich in resources. The creation of school clusters helps minimize duplication, promotes resource sharing, and facilitates better utilization of the limited resources.

Governance. The general education system of Sri Lanka, which was heavily centralized in the past, is on a rapid move towards decentralization today. A decision made by the Cabinet in February 1988, to establish Provincial Councils in each of the nine provinces of the country, and devolve some administrative and managerial functions held by the Ministry of Education to the provincial level was the beginning of this trend.

In the new mode of governance, a Provincial Minister, advised by a Provincial Board of Education, is responsible for education at the provincial level. A province also has a Provincial Department of Education headed by a Provincial Director of Education (PDE), whose responsibilities are twofold. First, the PDE is responsible to the Provincial Minister of Education in respect of functions assigned to the province. The PDE is also responsible to the national Ministry of Education with respect to central functions delegated for implementation on an agency basis.

Divisional Education Offices, according to the Ministry of Education (1988), act as administrative outposts of the Provincial Departments of Education. These, approximating 100 in number for the whole country, are manned by an Assistant Director of Education. Each Division covers 10 to 15 school zones, each of which on average has 10 to 15 schools. A School Board established for each zone generates additional resources, and endeavours to provide the best possible schooling to the community. The school clusters identified basically on a zonal basis come under the jurisdiction of School Boards.

The proposed innovation intends to focus on national schools that remain outside the school zones but within the purview of the central Ministry of Education.

Computers in General Education

Policy Initiatives. The School Micro Electronics Programme Committee, of which the Minister of Education is the chairman, is responsible for policy decisions regarding educational technology. The educational policy in the technology area focuses on the development of general computer literacy and considers Computer Science as an optional subject in the senior secondary curriculum. The policy also requires informatics to be introduced to the system gradually from higher to lower levels. This choice is dictated by logistical reasons and not through any unawareness on the part of educational authorities of the advantages of the early exposure of children to information technology.

Trends in Educational Computing. The education system of Sri Lanka suffers from a variety of problems. Many schools are burdened with large classes. The teaching force includes a high proportion of untrained teachers. Those trained once, rarely get an opportunity to refresh their knowledge and skills. Administrators have little exposure to management training. A large number of schools are yet to be provided with basic facilities, and many still do not enjoy electric power.

These difficulties, however, did not allow the educational authorities of Sri Lanka to ignore modern technology in schools. Computers began to gain widespread popularity in industry and commerce, making available more and more technology oriented job opportunities. To cater to the increasing demand for computer literacy, a decision was taken in the early 1980's to expose students at least in some larger schools of the country to the products of modern technological development. This, however, had to be attempted with caution to prevent any disruption to the wider goal of upgrading the entire school system. Thus, a phased-in strategy was proposed, and the Computer Education Project (CEP), centrally supported by the National Institute of Education (NIE), commenced in the year 1983.

The controversy at the inception of the project was not regarding the need for computers in the schools of Sri Lanka, but on how computers were to be used in education. Should computer courses be organized for all school children or should they be restricted only to selected groups of students? Should computers be used across the school curriculum or should they be limited to a particular curricular area termed Computer Studies or Computer Science? In the event of the latter decision, should the computer courses introduced have a strong bias towards programming? These were some of the early concerns of the educationists who involved themselves in this challenging endeavour.

The project commenced with the selection of a number of schools with advanced level science facilities and equipped with colour television sets. The intention was to expose all students in Year 12 science classes to a 90-hour computer awareness course, which dealt with the concept of modern computing, the programming language of BASIC, and practical uses of computers. The project also attempted to identify the feasibility of using computers as a teaching aid. In addition, attempts were made to develop club activities, and to circulate a newsletter in all computer-equipped schools for the purpose of encouraging both teachers and students in the writing of simple programs.

The Sinclair Spectrum Computers as well as Laser 200 and Laser 700 computers were chosen at the initial stage because they were inexpensive. Lack of dealer support, possible discontinuation of the models, absence of disk systems, and other limitations with regard to necessary applications such as word processing, spreadsheet and database management made it inadvisable to purchase any more of these cheaper computers. Therefore, in 1986, a decision was taken to base the project on IBM PC type microcomputers with dual floppy disk drives and printers, and to use the existing 'Sinclairs' and 'Lasers' to support the computer clubs.

The initiation of the above programme entailed much more than hardware provision. Teacher training centres had to be set up, suitable personnel had to be identified and trained as trainers, administrative personnel at different levels of the system had to be familiarized with the newly introduced program, new software had to be developed or available software had to be evaluated and adapted to local curricular needs.

To meet the human resource requirements of the project, a training programme was defined in collaboration with a number of universities and hardware suppliers. This, to some extent, drew on the programmes developed in other countries. The BBC/NEC course widely used in Britain provide one example. The programme, thus planned, began with the training of personnel involved in the project at the national level and others selected to manage the six computer training centres originally established. The University of Colombo played a major role in teacher training. Computer and electronics facilities belonging to this university and two other large universities in the country were readily made available to the Ministry of Education to make the project a success. Table 1 denotes the number of schools to which the project was extended from 1983, and the number of teachers trained each year, from 1985 to 1989.

Table 1

Schools Selected for Computer Science and Teachers Trained by Year

Adapted from Perera *et al* (1990)

Year	No. of Schools Selected	No. of Teachers Trained
1985	112	120
1986	79	120
1987	102	140
1988	----	30
1989	----	60*

* Includes teachers retrained for use of PC type computers.

To motivate the teachers involved, and to provide them with better opportunities to carry out their assigned duties, a decision was taken to familiarize school principals as well as other supervisory post holders at the school level on the basics of the newly introduced programme. The implementation of this decision was expected to result in more effective plans, better monitoring and evaluation of project activities, and more appreciation of the work of teachers which is central to the success of any innovation at the school level. A similar awareness training was also planned for the supervisory staff at higher levels of the system to facilitate their management role with regard to the project.

The six training centres originally established were found inadequate for the extension of the project. Since at least 30 centres were required to cover all teachers targeted for training, a decision was taken to use the pre-service approach to teacher education as a supplement to the in-service approach already in use.

Trends in Administrative Computing. Many in the developed world assess gains due to administrative computing to be much higher and more immediate when compared to those associated with instructional computing. Nevertheless, the use of computers for educational administration has not been prominent thus far in the Sri Lankan educational context. Only a few large organisations at the national level currently use computers mainly in the area of information management.

The Ministry of Education uses computers for the Education Management Information System (EMIS) functioning currently at the national level. School census reports are generated annually using the information stored in the system. The EMIS at the national level will be extended to lower levels of the education hierarchy, once the newly established provincial governments meet hardware requirements of the Provincial Departments of Education. In view of making this project a success, attempts are also made today, to develop and procure the required software, and to identify and obtain the services of local and expatriate consultants. An on-line database is also planned to provide decision makers of the country with reliable and valid information. This information in the form of statistical reports and indicators will pave the way for quick and timely decisions. The information culture, thus established, is also expected to encourage administrators and planners at the local level to improve not only the accuracy of the data they collect and pass on to higher levels but the use they make of this information as well.

Besides these applications related to the EMIS, computers are also used at the national level for a number of other administrative purposes. Payroll management, processing of public examination results, selection of trainees to Colleges of Education, selections pertaining to the Grade 5 scholarship examination, monitoring of projects, and various statistical analyses in the area of educational research provide a few examples. Wordprocessing also plays a prominent role when documents and reports are needed in English.

Summary

The present social, economic, cultural and political situation in the developing world has caused many to argue against the adoption of computers in developing countries. Nevertheless, a clear comparative advantage exists in introducing computers in these countries along with a fair chance that they be accepted and used by the school community. Any postponement of the venture also can widen the technological gap between the developing and developed worlds. Considering all this, the government of Sri Lanka in the early 1980's took a number of computer policy initiatives. The creation of the Computer and Information Technology Council (CINTEC) for the formulation and implementation of national policy in technology is one such initiative. Policy decisions with regard to educational technology concentrate on the development of computer literacy and the introduction of Computer Science as an optional subject in the senior secondary curriculum. Although gains in administrative computing are known to be much higher and more immediate when compared to instructional computing, the attempts to introduce this type of computing have not yet moved beyond educational organisations at the national level.

The next chapter focuses on the need for computers in the administration of national schools.

Chapter 5

The Need for Computers in the Administration of National Schools of Sri Lanka

Introduction

Microcomputers, as noted by Brodman (1986), are not apolitical tools. Within any organisational context, some perceive microcomputer adoption as positive and some as negative whether for personal, organisational or policy reasons. In spite of this situation, many schools all over the world have introduced computers out of enthusiasm, curiosity or prestige, with little second thought to needs, costs, and long-term difficulties. This process has often made computers a short-term fad in schools.

The most immediate and impressive gains in productivity in educational organisations, according to Visscher (1988), are associated with administrative uses of computers. These gains, however, cannot be achieved when technological possibilities become the central point in making decisions for computer use. The tendency of the suppliers of technology to dominate the scene under such circumstances can lead to a number of problems. To avoid many unhealthy effects associated with this situation, the needs and wishes of the organisation and its members have to be identified in full, and tuned to various possibilities offered by new technology.

The 'why' questions, according to Hurley (1988) have to be addressed first, if the allure of the 'how' and the politics of the 'who' questions are not to delay and confuse the implementation process. This Chapter, therefore, aims at providing cogent and coherent arguments as to why computers should be taken seriously and utilized effectively in the administration of national schools of Sri Lanka.

Kaul, Walshman and Symons (1989), stressed the importance of the context of technology development for its ability to present both constraints on, and opportunities for technological change. This is particularly true for developing countries that function with strained education budgets and limited infrastructural facilities. As de Vries (1988) noted, educators of these countries often make the mistake of transferring a technological innovation from a first world educational environment to a third world one without closely considering the differences between the situations and the infrastructures. Since the national schools of Sri Lanka provide the context for the innovation under concern, this chapter begins by considering the structural and functional organisation of these schools.

National Schools of Sri Lanka

The national schools of Sri Lanka cater to the educational needs of the most promising and deserving students from all parts of the country. Led by efficient principals they also act as model schools for effective practices in both instruction and administration. The intention of the Ministry of Education is to develop these schools as centres of excellence in the field of education.

Structural Organisation. The management of national schools rests with a well established Central Management Committee, where the principal of the school is the head. Besides the principal, this committee includes two deputy principals and a number of sectional heads. One of the two deputy principals is in charge of school finance and general administration, while the other is responsible for the co-ordination of the school's curricular, co-curricular and welfare programmes. The appointment of sectional heads is usually by level (primary, junior secondary, and senior secondary) or by various sub-divisions within these levels.

The organisational structure of national schools also includes two other supervisory posts, namely grade co-ordinators and subject co-ordinators. The grade co-ordinators bear responsibility for administrative aspects of the school at the grade level, while subject co-ordinators are responsible for the subject areas assigned to them. Teaching staff of national schools have dual responsibilities. As class teachers they are accountable to grade co-ordinators for day-to-day administration of class level chores. As subject teachers they have a responsibility for instruction, and therefore are accountable to subject co-ordinators. School prefects and class monitors are two student categories that assist school administrative personnel. The student subject leaders, selected on the basis of academic ability, assist subject teachers to discharge their teaching duties. Figure 4 denotes the organisational structure of national schools.

The structural organisation described above is mainly to improve the quality of supervision conducted at the school level, and to pave the way for more efficient and effective school management. In order to facilitate the smooth execution of plans and policies, an attempt is also made to define clearly the duties and responsibilities of all types of supervisory personnel and delegate duties to them with adequate authority. The next section outlines some important responsibilities assigned to different types of supervisory post holders.

Functional Organisation. The principals of national schools, who are in overall charge of their respective schools, also bear special responsibility for the development of academic standards. The two deputy principals relieve them from most of the routine work pertaining to any large school, providing them more opportunity for school development. The deputy principal (curriculum) along with the subject co-ordinators assist the principals in the supervision of the academic aspects of the school. The sectional heads co-ordinate the work of each section, while the grade co-ordinators undertake similar responsibility for parallel classes within each grade.

The deputy principal in charge of finance and administration in a national school is responsible for student services; administration of academic and non-academic personnel; preparation of the annual budget, accounts and financial reports; maintenance of stores and supplies; handling of disciplinary matters; and hostel administration. The deputy principal in charge of curricular, co-curricular and welfare activities is responsible for the quality improvement of the teaching-learning process; maintenance of records; development of associations and clubs; organising of cadeting, scouting, sports, religious activities and competitions; the functioning of both the School Development Society (SDS) and the Past Pupils' Association (PPA); and also for affiliation with various national and international organisations.

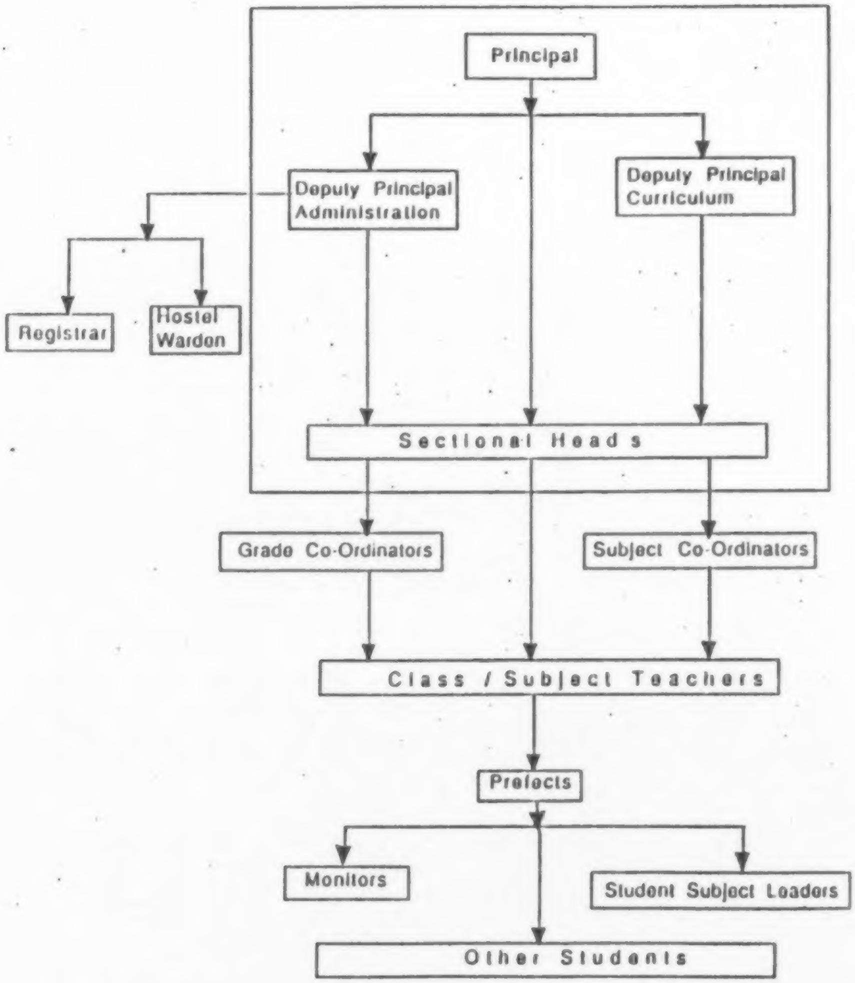
Principal
Deputy Principal Administration
Deputy Principal Curriculum
Registrar
Hostel Warden
Sectional Heads
Grade Co-Ordinators
Subject Co-Ordinators
Class / Subject Teachers
Prefects
Monitors
Student Subject Leaders
Other Students

Figure 4

Organisational Structure of National Schools

The sectional heads undertake all administrative matters pertaining to their sections. They attend to disciplinary matters, staff and student attendance, preparation and implementation of timetables, assignment of relief work, maintenance and updating of pupil records, collection of facilities fees, and meeting with parents. The grade co-ordinators assist the sectional heads to perform these duties at the grade level.

The major function of the subject co-ordinator is to assist in the improvement of instructional quality. With this in mind, the people appointed to this post are assigned the duties of distributing syllabuses and course guides, assisting in the preparation of work schemes, ensuring the timely coverage of syllabuses, organising for remedial teaching, and attending to student and teacher evaluations.

The above description of the organisation of national schools clearly indicates the complexity of this type of school in terms of structure and functions. To simplify the management of these schools, a need, therefore, exists to computerize at least some of their more time consuming and difficult administrative tasks. The next section attempts to justify why national schools gain priority over other schools in the proposed computerization process.

Why Select National Schools for the Innovation?

The education sector that forms the critical backbone of any developing society requires radically innovative and unconventional solutions for better services and greater development. Restricted educational budgets in most developing countries, however, do not allow such solutions to be considered for the school system as a whole, but there is every opportunity to encourage at least some larger schools to give up conventional solutions that are inadequate and inappropriate. In the Sri Lankan education context, this priority rests with the national schools which are large in student and teacher numbers, physical facilities, and curricular offerings. As Baum (1979) noted, computers in small schools may not show a conspicuous advantage over the manual method to justify the expense and upheaval involved in changing to an automated system.

Even though Sri Lanka demonstrates a high literacy rate when compared to other developing countries, it still has a long way to go in the path of development. This requires that at least the most promising students of the country be exposed to a complete education, where they come to understand the value of new technology and its practical use in the work place. Such education also helps enhance the competitiveness of these students on the international scene.

The national schools of Sri Lanka, although dispersed throughout the country, are managed and controlled by the Ministry of Education as one single group. The centralized control thus exercised makes all principals follow similar directives and carry out duties assigned to them in a uniform manner. This simplifies planning for the innovation as well as its organisation, direction and control. Moreover, the same arrangement allows hardware to be purchased in bulk, software and training programmes once developed to be used across the system, and maintenance to be organized centrally for the full range of national schools. All this not only reduces costs and enhances the economic feasibility of the innovation but also ensures the credibility of national schools as the most appropriate starting point for computer-based school administration.

With the computer education programme of the Ministry of Education now in full implementation in all national schools, these schools have not only access to computers but also direct operational experience in the area of computing. With support from the community and past students, most national schools also have taken the initiative to increase their stock of computers. Given the affluent community umbrella within which these schools are managed, there is also a degree of faith that these schools can fund the innovation beyond donor funding. For the same reason, this project launched in the national schools may not have to compete with funds going into other priority areas.

National schools, popular and prestigious, also have most of their basic needs met. Further, they are managed by well qualified and efficient principals, who are capable of handling change and innovation. The aim of the innovation is also not to spread benefits thinly to the greatest possible number of students but to help the most academically talented youngsters of the nation to achieve excellence. All this makes it well worthwhile for the proposed innovation to focus on the national schools. The next section looks into some administrative problems encountered by these schools, which the use of computers can very well solve.

Some Administrative Problems in the National Schools.

National schools are complex organisations with many people fulfilling a number of specialized tasks. The principals here have the overall responsibility for every aspect of the school, whether it be instructional or administrative. Some specific duties they carry out are making policy decisions at the school level, formulating and implementing short-term and long-term plans to meet various developmental needs of the school, monitoring the progress of school projects, accounting for funds, and evaluating the effectiveness of the school's academic programme. The principals are also responsible for buildings and grounds, supplies and equipment, student admissions, scheduling, staff supervision, and community relations. Computer technology, with implications for all this, is therefore, important in the context of the national schools.

Bird (1986) classified the tasks of school administrators into two groups. The administrative tasks, the first here, are clerical in nature. These tasks facilitate the orderly progress of the organisation, and consist of a number of background tasks without which the day-to-day work of the school cannot take place. The management tasks on the other hand, require higher order value judgements, and include planning and decision making where data needs to be processed, rearranged and considered.

In national schools, the deputy principals undertake most of the administrative tasks manually. Thus, they play the role of high level clerks or administrative assistants with little time to facilitate what goes on in the classroom. The management tasks, also undertaken manually by principals themselves, are performed far below the optimum level mostly due to limitations in human capability for adequate analysis and evaluation. Further, according to Brodman (1986), certain tasks both managerial and administrative do not become feasible by manual methods because of time limitations, practical difficulties and managerial constraints. All this highlights the need for computers in the administration of national schools.

The World Bank (1983) identified the managerial problem as one of the most common implementation problems in developing countries. Productive management resources are scarce in the Sri Lankan educational context as well. A substantial amount of time available to this scarce resource is spent on clerical work such as filing routine reports and record keeping. The low typing skills of secretaries also force school administrators to spend excessive time and energy in proofreading typewritten documents. Even if managerial skill is in adequate supply, there is clearly no point for highly qualified and well paid professionals to undertake work that a computer can perform more efficiently and effectively. Computers can increase the productivity of national school principals by increasing the number and variety of responsibilities they can handle. Acting as management tools, computers also enable these people to become more analytical, ask better questions, and arrive at better answers.

Schools require different types of resources, all of which are already strained. Aid from the community although possible for national schools is often uncertain and unstable, and therefore, better considered as a contingency fund. Under these circumstances, the only hope for future improvement lies in the better management of available resources. Computers that are of assistance here thus become valuable to national schools.

Time, according to Huntington (1983), is one resource an administrator cannot increase. This situation, true for national school principals as well, requires them to conserve and manage time appropriately. Computers when properly used, permit large savings in time which the principals can use to work directly on other vital leadership functions, and to be more accessible to students and staff as they try to accomplish school goals.

The student enrolment in national schools increased over the years, with no corresponding increase in the support staff. The accumulated effect of this has overloaded the secretarial system of these schools today, bringing it almost to the point of breakdown. Computers enable more work with the same staff. They also allow the maximum to be made of the large base of non-trained teachers in the national schools. Training this semi-skilled labour to perform some computerized tasks not only minimize the need for additional clerical staff but also enable effective use to be made of the time of the non-professionals.

The national schools are burdened today with an overwhelming diversity of information needs. Although information handling is important to these schools for the role they play as both sources and users of information, most of them do not have adequate systems for the purpose. The manually run information systems of the national schools are underdeveloped in terms of the quantity and quality of the data they maintain. The longstanding practice of storing data in paper files also requires large storage space. Although attempts are made to maintain files systematically with proper indexing, the current rate at which records are created makes access to information both difficult and time consuming. The information stored manually is also not amenable to complex analyses either due to limitations in human skills, or due to non-uniformity of data collected across activities. The UN (1985) identified these weaknesses in information handling as major constraints on organisational efficiency. Computerised information systems help overcome most of these problems.

Former students seeking admission to tertiary education, or applying for specialized training, or for jobs, often rush to schools in search of references and transcript information. With manual methods of record keeping, such requests can only be satisfied through a frantic search of student record cards which are usually stored in dusty attics. The long delays associated with this process coupled with frequent loss of important records frustrate past students who are a valuable asset to any school. Computers provide better means for information access and retrieval, and facilitate this task as well.

The school principals of Sri Lanka also have a responsibility to supply school statistics once a year for school census purposes. In the highly centralized education system of the country, the school personnel are little involved in data processing. This situation, coupled with the long cycle-time required for data validation, drastically reduces the quality of the data passed on to higher levels. People at the school level, when used merely for data collection, also see no return for their efforts. Placing computers at the point where the data are generated, makes it possible to develop local applications which use the same data as the larger system. This makes the system to be considered as "our system" rather than "their system," and improves both the timeliness and accuracy of the data collected.

The principals, deputy principals, and other senior staff in national schools are faced with the need to make decisions. Although such personnel are also expected to anticipate problems constantly and act upon them quickly, the pressure of day to day events forces them into a reactive stance which makes this impossible. Moreover, the principals have to justify their decisions to critics and concerned parents. For this, the decisions they make should not be by rule of thumb or by rule of private interest, as is usually the case, but on the basis of high quality information. Computerized information systems with attributes of timeliness, accuracy, relevancy and completeness promote informed and unbiased decisions in national schools.

School level planning, a critical task in the context of national schools, mediate between national plans and parental needs. This task, which involves complex decisions among a multiplicity of choices, is further complicated by the variability of the situation. All this demands advanced skills from school administrators which are usually scarce in supply. Comprehensive and long-term plans are even more difficult to formulate due to the amount of detail required for their formulation. Computers when used for planning help overcome this skill deficiency to a great extent.

In addition to planning, national school principals are burdened with the task of monitoring the developmental projects they formulate on an annual basis. In this respect, they have to keep track of the time spent on each project, the activities covered, the resources utilized, and the quality of the work accomplished. Furthermore, they have to monitor the performance of the staff and the students, and the use made of space and other expensive facilities. All this requires ready access to control data pertaining to performance and utilization, and also the facility to analyze such data in detail. Nevertheless, both feedback and feedforward information generated in national schools through the use of current manual methods are often inadequate, late in arrival, and do not lend themselves to sufficient analyses. Computers, with implications for all this, play an important role in national schools.

Instructional management, according to Randall (1989) is another area appropriate for computer use. Timetabling, student scheduling, assessing and reporting of student progress, identifying slow learners for remediation, clinical supervision, and evaluation of the school's academic programme consume considerable time and effort when undertaken manually. Computerizing at least some aspects of this important area can help national schools achieve their goals of excellence.

Absenteeism, in the opinion of many principals, is one perplexing student problem. This, according to Duckworth (1988), contributes to poor academic performance, and a subsequent rise in the student dropout rate. One way to overcome the problem is to improve the information available on student absenteeism. Attendance accounting when undertaken manually can only satisfy the reporting requirements of higher authorities. This situation leaves no room to identify causes for student absenteeism, nor detect methods to deal with them. Computerisation allows the home, personal and school problems of students who have a disproportionate number of absences to be maintained systematically. It also enables a more precise system for monitoring and recording of truancy, especially selective class cutting. All this enables early action, and helps solve the problem before it gets acute.

Computers also become handy in the process of student counselling. The opportunity they create to call up all the needed information in a matter of moments, enables the counsellors to spend more time with problem children, and to provide them a better service.

National schools of Sri Lanka are distanced from one another. This makes them function in isolation with little knowledge of the undertakings or performance of their counterparts. Individual departments of these schools also function in isolation. The data maintained on a departmental basis do not create adequate grounds for data comparison, and prevents the departmental heads from being critical of the work of other departments. Timely information pertaining to one's counterparts, according to Alvarez, Smiley, and Rohrmann (1985), increases competition among educational units, and helps them react quickly to changing situations. Computers with immense capability for information handling, therefore, can be of value to national schools.

Healthy linkages with parents and wellwishers in the school community are a prerequisite for the development of any school. Although the importance of this is well understood, national schools are often criticized for the low level of relations they maintain with their school communities. Problems of communication become acute, particularly in the presence of a large parent body. Many advantages associated with wordprocessing could readily improve this.

Research is an important task which is often neglected in national schools. Manual methods currently used for research are not very effective in analyzing school problems. A principal, for example, may wish to get more insight into a problem by correlating student achievement with school supplies, or truancy rates with various characteristics of the timetable. To detect problems, school administrators also need to be aware of important trends. Manual methods are not suitable for the analysis of data collected over long periods of time. If national schools are not to miss important opportunities for school development, a clear need exists to use computers for research.

National schools incorporate all three levels of schooling, namely primary, junior secondary, and senior secondary. This generates the need to prepare students for three public examinations each year. In the absence of computers, the administrative routines associated with these examinations cover the whole year, and fill a large part of the time of the deputy principal in charge of external examinations. Computers in national schools can simplify this task and release the people responsible for more productive work.

National schools also maintain three major funds, namely the Facilities Fees Fund, the School Development Society (SDS) Fund, and the Past Pupils' Association (PPA) Fund. The Facilities Fees Fund is derived from the facilities and services fees each student is required to pay on a term or yearly basis. The SDS fund accounts for monies collected from parents and wellwishers in the community, while the PPA fund deals with contributions from past students. Proper maintenance of the above funds necessitates three different types of budgets to be prepared early each year, and expenditure patterns to be monitored to avoid over- or under-spending. Computers that facilitate financial planning as well as monitoring of financial performance thus become important in the national school context.

Schools of Sri Lanka have long functioned with structures and procedures both outdated and inappropriate. Rigid chains of command and lines of communication in these organisations resemble a classic bureaucratic design which tends to perpetuate the past, resist change, and delay the attainment of educational goals. Such structures, according to Wilson (1977), hinder other more profound innovations in education such as curricular reforms. The school principals, burdened with day to day work, can hardly find time to analyze the existing structures and procedures for further improvement. Barone (1987) identified change as the steady state in computing. Office automation facilitated by computers calls for a radical restructuring of administration in terms of office work and organisational structures. This undertaking also provides administrators with the time they need to rethink objectives and functions of the service as well as the capabilities and desires of its personnel, and helps meet a long felt need in national schools.

Decentralization is one change that is taking place in the Sri Lankan educational context. Stewart (1971) identified this as a trend that lowers the level of management at which most decisions are made, and brings all concerned more directly into the decision making process. For decentralization efforts to be successful, the people throughout the organisation have to be provided with accurate and relevant information. Computers with sound capability in this regard help democratize school administration.

The management of national schools today is becoming increasingly difficult due to a variety of economic and social factors. The rising educational costs with declining educational standards, tighten educational budgets and compel educational administrators to be more and more accountable. Cries for accountability generally call for more objective evaluations, better methods for monitoring school expenditures, and additional requirements for information reporting. Computers that help school administrators in most of these tasks have implications for the accountability aspect as well.

National schools suffer from a number of problems that are prominent in the macro education system. Teachers are paid very low salaries. Women have little opportunity to take up administrative positions. Many liberal arts graduates continue to be underemployed. Seniority-based promotional schemes stagnate capable youth for long years in the lower levels of the educational hierarchy. Many office tasks that teachers and clerks have to perform in national schools also do not enliven a school day. The ultimate result of all this is a set of demotivated staff, with whom the principals find it very difficult to work towards educational goals. According to Brodman (1986), "microcomputer adoption has the potential to alter the hierarchy of skills and rewards" (p. 36). This also opens up avenues for many who presently have limited opportunities and frees school personnel from the drudgery of every day tasks. All this improves staff morale, and contributes to better performance.

Other Situations that Call for Administrative Computing in the National Schools

According to Samaranayake *et al* (1987), Sri Lanka has the potential to produce computer professionals in large numbers. With proper motivation and guidance, the educated manpower in the country can be easily converted to computer users. Systematic introduction of computers for school administration will enable all in national schools to be familiar with new technology, and adapt themselves to the demands of an information society.

The decision to provide instructional computing has already been made in the Sri Lankan educational context. Research also suggests that it is economical to develop administrative and instructional computing together. Moreover, the hardware and software costs for administrative computing are comparatively low, and according to Bluhm (1987), approximate one half the size of that needed for instructional computing. When these are taken into consideration, there is clearly no point in delaying administrative computing in national schools any longer.

Computers in the administration of national schools will contribute to the success of the computer education program now in full implementation in all schools of this type. First, the use of computers provides the principals of these schools with the knowledge, skills and attitudes they need to implement the above program successfully. Second, it will encourage the teachers to take the plunge into using computers for teaching purposes. According to Huntington (1983), teachers become less afraid of computers when they see their superiors using them. Third, administrative computing in national schools helps meet some of the major expectations of students in the computer education program. Students who are exposed to administrative applications, according to Lancaster (1985), expect the claims made in the classroom on the administrative potential of the computer to be reflected within their own school. Using computers for school administration helps meet this expectation as well.

The Need for Administrative Computing in National Schools

As indicated earlier, the national schools suffer from a series of administrative problems which computers can very well solve. Technology, however, is not the only solution for most of these problems. This fact makes it worthwhile to identify alternatives to administrative computing and to explain why computers provide a better solution for the broader problem of school administration. Justification of the need for administrative computing thus is useful particularly in the context of a developing country that functions with restricted education budgets and scarce foreign resources.

Currently, the national schools operate with very few or no clerical staff. As a result, the teachers spend a substantial portion of their valuable teaching time on routine administrative chores. This situation hinders both the efficiency and the effectiveness of schools. An increase in the clerical staff available to the national schools can be a low cost solution for the above problem as well as a better substitute for administrative computing that involves high capital costs.

Large clerical staffs already employed by higher levels of the education system, however, have proved to be unsuccessful. Underemployment, low salaries, routine repetitious work, limited chances for promotion and excessively secure jobs with low probability for dismissal are some reasons for this situation. When compared to computerized methods, manual methods of any form are also less reliable and much less accurate. Moreover, limitations in human capacity do not provide optimum solutions for tasks that require adequate analysis and evaluation. Many practical difficulties hinder the performance of managerial tasks such as information handling, planning, decision making, monitoring, evaluation and research that are important for the effective accomplishment of school goals. Manual methods also provide no solution for those tasks that do not become feasible due to managerial constraints.

Furthermore, the demand for information processing at the school level is not equally distributed across the year. Certain events such as school censuses, sports meets, prize givings, end-of-term examinations and public examinations call for high clerical activity during certain periods of the year. Hiring additional clerical hands only for such periods is not administratively feasible. One solution for the above problem is to pay overtime for the existing staff. The other solution is to maintain a large clerical staff cadre througout the year. Meeting the periodic administrative needs through the first method can bring down the accuracy and reliability of information handling. The second method is also inefficient when the idle time of staff, during the low activity period, is considered. When all of these facts are taken into account, continuing to use any form of manual method becomes inappropriate for the administration of larger schools of Sri Lanka.

Computer aided administration leads to high payoffs when used under the right conditions. The issue today therefore, is one of proper utilization rather than any arguments over the need for the innovation. This situation, according to Sanwal (1989), compels the planners to find out how the new technology could be best accepted by administrators and absorbed into all levels of the educational hierarchy. To form the necessary background for this, the next chapter considers the expected role of the computer in the administration of national schools.

Summary

The needs and wishes of the organisation and its members should play a central role in assessing the need for computers in school administration. The size of the schools, the scope of their activities, the governance structure, and the support they can channel from the outside favour an immediate venture into computerizing of national schools. Technology also has a lot of potential in overcoming many administrative problems encountered by the schools concerned. They release the scarce management resources for more productive jobs; solve many difficulties associated with instructional management; make examination administration less tedious; help overcome the problem of absenteeism; support guidance and counselling services for students; improve linkages both within the school as well as with the outside school community; improve the accuracy of the information collected; motivate staff; and facilitate planning, decision making, problem solving, monitoring, evaluation, and research.

Chapter 6

The Role of the Computer in School Administration

Introduction

New technology is used more and more in schools today. Although not a panacea for all ills, there is ample evidence to prove that computers can overcome many problems faced by school administrators. For maximum benefits, careful planning is required on a clear understanding of the role of the computer in school administration.

Development, according to the UNDP/ILO Study Team (1982), concerns the effective and efficient use of resources. Computers, although powerful in many aspects of management, do not contribute to development unless used correctly. Some schools have introduced computers merely as status symbols rather than for the work they can do. This practice, according to Clement (1989), has caused schools to miss many exciting and potentially beneficial aspects of computing. Some schools, ignorant of the use to be made of the new technology, have determined applications after purchasing the equipment. This common practice has the danger of implementing less urgent applications at the expense of more urgent ones.

School principals are busy people with many claims on their time and attention. Most of them are preoccupied with problems of implementation, suspicious of change, and hesitant to jump at innovations that may disrupt the smooth functioning of their organisations. User-suspicion may be associated with lack of understanding. An awareness of the role of the computer helps ensure user acceptance of the innovation through informed judgement rather than by persuasion or selling. Such an awareness also provides the user managers the understanding they need to work co-operatively with computer specialists.

In moving from a manual to a computerized system, the administrators under concern have to formulate clearly their expectations of the new system. Nevertheless, managers tend to abdicate this responsibility mainly because they feel they do not know enough about the new area, and also because they are afraid of asking common sense questions. Limited knowledge of the role of the computer further prevents managers from making constructive criticisms that are important in developing systems.

The advice this chapter intends to provide on the role of the computer in school administration enables user managers to select applications that are appropriate in their own contexts or at least to validate the applications already identified for them by persons with expertise. Such participation, according to Patel (1987), is very important especially when it comes to making changes in organisational structures and operations.

To be successful, the schools should start with a set of applications that are considered as appropriate for computerization. This not only provides a firm footing for policy making for the entire innovation but also helps the priorities identified to be laid out in a long-term plan. Both of these measures prevent ad hoc development of disjointed applications and contribute to optimal impact.

With the need to be aware of the role of the computer already clarified, the main thrust of this chapter is to develop a model to illustrate some priority applications for national schools of Sri Lanka. The literature is reviewed as a preliminary step to identify what factors help determine the role of the computer. Next, the experiences of others, elsewhere, are considered to select and categorize some administrative applications that are widely in use. Finally, an attempt is made to identify a few implementation priorities, and to provide a brief description of each.

Factors to Consider in Determining the Role of the Computer

Despite discouragement and set backs, organisations in the developed world, large and small, private and public, have persevered over a period of many years to develop their ability to use computers. As a result, the bulk of the experience in using computers rests today with the developed world. The whole of this experience, according to Bingxun and Angell (1990), may not be practical in a developing country context, where the situation may be very different from that of a developed country. Advancements in technology can also make some experiences of the developed world obsolete. All this requires developing countries to be cautious in trying to benefit from the experiences of others.

As Kaul (1987) noted, an awareness of the experiences in the private sector also proves useful in developing computer applications in the public sector. This is particularly true in situations where the former is well ahead in the task of computerization when compared to the latter. Schools also require some awareness of the computerization processes adopted at higher levels of their own hierarchy and also at other educational institutions. The former helps enhance the compatibility of school computer systems with those of higher authorities. The latter enables schools to select applications that are appropriate in an educational environment.

Mere reproduction of applications currently in use is also not appropriate. This, according to the Minnesota Educational Computing Consortium (1978), can strengthen unsatisfactory approaches that could be modified later only at a great expense. The changing school systems require due consideration to be given to frontiers that are likely to open up in the future. As Dow and Fritz (1985) noted, the use of microcomputers therefore, should go beyond present experience.

New technology, according to Ogilvie (1981), requires concomitant changes in organisational structures, procedures and responsibilities. Such radical departures from existing patterns generate user resistance. As Stewart (1971) noted, many planners who fear this situation tend to initiate administrative computing with trivial rather than important applications. As a result, they often fail to progress beyond routine clerical work. Experiences of the developed world, according to Smith (1979), reveal that certain simple uses of computers are uneconomic (cost more than a manual system) and unnecessary (no more effective than a manual system). Computerizing these can also replace jobs that require numerical ability, experience and judgement by others that need mere transcription skills, and bring about a skill reduction. Complex uses of computers on the other hand are difficult to achieve, and are risky in the sense that they cost a great deal of money and still may not yield the needed result. Yet, Smith (1979) recognized these uses as the most beneficial, and the need to consider them in determining the role of the computer in school administration.

A tendency also exists to consider technology as an end rather than a means to an end. According to the National Task Force on Educational Technology (1986), cited in Randall (1989), technology by itself should not be an educational goal, rather its use should help achieve educational goals. A number of critical obstacles, according to Thurber (1973), deters organisations from achieving the desired goals. The previous chapter discussed some current problems in the area of administration. To be successful, the selection of computer applications should relate to organisational goals and problems.

Elmore (1978) in advocating the approach of backward mapping identified the problems and needs of users in schools as the primary basis for planning. Stewart (1971) also preferred the systems to be designed with the user needs in mind. This contradicts with the idea that computerization is evolutionary and that user needs should emerge as technology becomes available. Figure 5 provides a diagrammatic representation of the major factors that need consideration in defining the role of the computer.

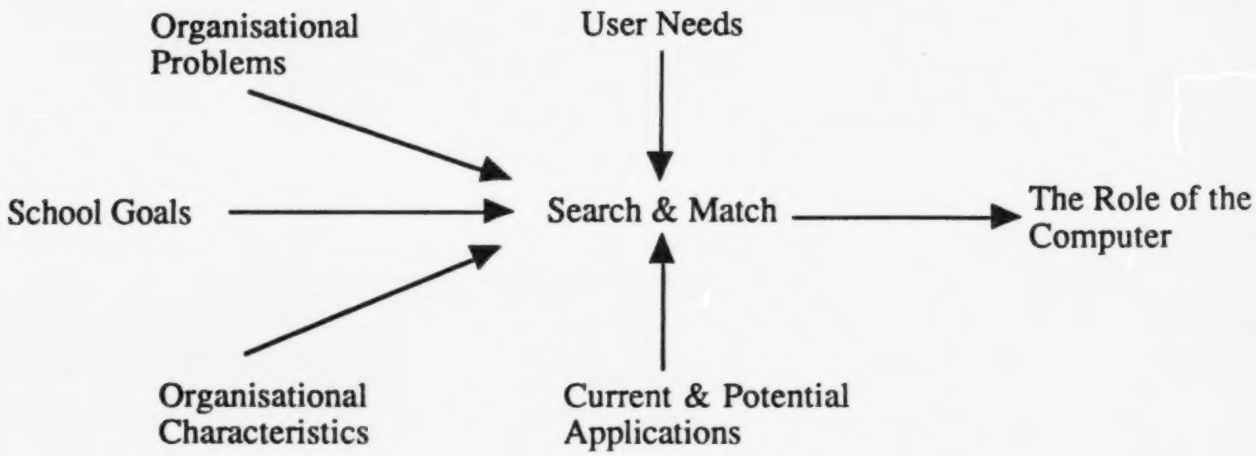
Organisational Problems
User Needs
School Goals
Search & Match
The Role of the Computer
Organisational Characteristics
Current & Potential Applications

Figure 5

Some Considerations in Determining the Role of the Computer

Classification of Administrative Applications

Computers in education have roles both in instruction and administration. Hurst (1987) found the role of the computer as a teaching tool very limited and the automated classroom a myth even in the developed world. According to Ogilvie (1981) and Hurst (1987), the administrative uses of the computer demonstrate clear advantages.

Administrative computing in education commenced with routine administrative tasks such as payroll, sales / purchases ledgers, and stock control. Lancaster (1985) noted, a change in the focus of administrative computing from a concern with improving existing procedures and developing administrative tasks to the development of new procedures and establishment of managerially oriented applications. In determining the tasks to be computerized, Patel (1987) also stressed the need to concentrate more on development-oriented managerial functions. Some general guidelines formulated by Smith (1979) indicated that computers in schools should be used for central functions such as predicting, planning and scheduling, and also to do what is impossible by hand.

Identified applications, have to be classified to facilitate conceptualization. A classification scheme developed by Patel (1987) is given below. This incorporates six application types under clerical, management, and public systems.

1. Clerical Systems

These systems handle large volumes of data primarily to introduce order and timeliness into clerical functions, and to improve the productivity of clerical personnel. Three types of applications come under this.

1.1 Statistical Compilations

These are designed to collect data from a number of sources for the purpose of tabulating, summarizing and compiling statistical reports.

1.2 High Volume Transaction Systems

These are concerned with situations where a large volume of transactions have to be received on a regular basis for the creation of new records or for the updating of existing ones. Such systems facilitate rapid answers to queries, provide quick simulations for future planning, and help share data among organisations.

1.3 Office Automation

Computers are used here to perform typical clerical functions such as writing letters, filing correspondence, sending mail and memos, and scheduling meetings and appointments.

2. Management Systems

These draw upon the three systems discussed earlier to assist managers in decision making, planning and control.

2.1 Monitoring Systems

These enable comparisons between actuals and targets, highlight exceptional conditions, recognize trends, and provide administrators a firm grasp of the activities for which they are responsible.

2.2 Decision Making Models

These help construct mathematical models of a given problem to facilitate an optimal solution, and to check the sensitivity of the solution to possible changes in underlying variables.

3. Public Systems

3.1 Public Participation Systems

These systems call for a change in the present bureaucratic orientation in organisations by opening up data to the public. Their contribution to development is based on enhanced community participation in organisational activities, better awareness of leaders of what others elsewhere have achieved, and improved researcher access to organisational data.

The literature identified a number of other classifications specific to education. A classification scheme by Demchak (1986) incorporated four subsystems namely instruction, instructional support, personnel, and accounting / purchasing. The UN Department of Technical Co-operation for Development (1985) investigated computerization under the categories of policy making and planning, internal management (personnel / financial / project management), and regulation. Ogilvie (1981) identified three major areas of computer use and referred to them as educational management functions (student records, attendance, timetabling), business operations (inventory keeping, accounting), and communication functions (wordprocessing).

Following a somewhat different approach, the Minnesota Educational Computing Consortium (1978) classified potential computer applications under five headings: students, personnel, facilities, finance, and general. A listing of administrative applications prepared by Spuck and Atkinson (1983) incorporated office applications, research and planning applications, and library applications in addition to the five categories mentioned above. The Leeds City Council (1988) identified the need to amalgamate academic, administrative and financial data to assist in the planning and management of education, and developed a classification scheme that incorporated all these areas.

A Framework for Administrative Computing in National Schools

All schools that fall under the umbrella of national schools have similar goals, organisational environments and functions. The problems and needs of these schools which are more or less the same, allow the development of a common framework for all schools covered by the project.

As a first step in developing the framework, the application areas discussed earlier were analyzed in detail to identify a number of subsystems and a set of elementary activities under each subsystem. Elementary activities, according to Essink and Visscher (1987), are organizational processes that cannot be broken down into independent parts. The preliminary set of elementary activities identified were further analyzed to detect a few that computerization could effectively support.

The framework developed for administrative computing in national schools incorporates seven subsystems in total. Higher order applications such as planning and management, with no subsystem of their own, are incorporated within other subsystems as appropriate. Figure 6 illustrates this framework.

Some Priority Applications for the National Schools

Schools are often over-ambitious in the task of computerization. As a result, they tend to undertake more tasks than they can really manage at one particular time. According to Bird (1986, p.186), "One task achieved well will be much better than several done badly or left unfinished." This requires the identification of a few implementation priorities.

Student Applications

Enrolment Projections
Registration
Scheduling
Attendance Accounting
Performance Monitoring
Progress Reporting
Transcript Processing
Discipline Handling
Counselling
Career Guidance

Curricular/ Extra Curricular Applications

Timetabling
Test Scoring and Analysis
Selecting Students for Remedial Teaching
Scheduling Extra Curricular Activities
Determining Student Awards
Public Examination Admissions
Analysis of Public Examination Results

Staff Applications

Manpower Planning
Scheduling
Training
Salary Simulation
Pay Cheque Calculation
Supervision
Performance Evaluation

Financial Applications

Revenue Projections
Preparation and Monitoring of School Budgets
Accounts Receivable and Payable
General Ledger
Purchase Order Generation
Preparation of Financial Statements

Facilities and Equipment

Facilities Planning
Inventory Control
Maintenance Scheduling
Energy Management
Property Management
Booking of Shared Facilities

Support Services

Media Reservations
Distribution of Free Textbooks
Library Applications
Transportation Scheduling
Issue of Bus Passes
Mid-Day Meal Management
Research

Office Applications

Statistical Returns to the Ministry
Preparation / Editing of Reports
Preparation of Standard and Individualized Letters
Messaging (Electronic Mail)
Calendar Management
Scheduling of Meetings
File Management

Figure 6

A Framework for Administrative Computing in the National Schools

Effective prioritization requires a number of factors to be considered. According to Patel (1987), users at the outset demand simple applications that are primarily operational. They also prefer smaller files and more time for learning. With time and experience, a shift may occur from operational support to decision support. Patel (1987) also noted a shift in user concern over costs from cost avoidance to cost justification and finally to cost saving.

To avoid embarking on more applications than one can comfortably handle, the areas outlined in Figure 6 were carefully analyzed, and a few applications were identified to be implemented within a five-year period. Areas such as information management, wordprocessing and electronic communications were given high preference in this selection for the reason that they provide the background for a number of other applications. The urgency of the need, the complexity of the task, the expertise available to schools, and limitations in infrastructural facilities are some other factors considered in the selection process. To facilitate the task of policy makers, the priority applications so identified are discussed below in detail.

Information management. Most applications identified for implementation require four types of information: descriptive, diagnostic, predictive and prescriptive. These information types, according to Harsh and Weber (1985), try to answer four basic questions: What is?; What is wrong?; What if?; and What should be done?. With the need for information evident, Figure 7 illustrates a framework for developing information systems in the national schools.

Student Database

Demographic Information (Name / Sex / Birth Date / Ethnicity etc.
Family Information
Interests and Special Talents
Health Records
Discipline and Guidance Records
Daily Attendance Records
Academic Undertakings and Progress
Participation / Performance in Extra Curricular Activities
Graduate and Follow-up Records

Staff Database

Demographic Information
Employment History / Internal Promotions
Special Interests and Talents
Assignments (Academic / Non-Academic)
Leave and Salary Records
Certification and Training Particulars
Supervision and Evaluation Reports

Instruction and Instructional Support

Subject Information
Class Information
School Timetables
Test Item Banks
Remedial Teaching Records
Public Examination Results

Finance and Facilities

School Budgets
Records of Deposits and Investments
Income and Expenditure Records
Purchase Orders and Invoices
Vendor Reports
Equipment Inventories
Room Locations and Capacities
Room Assignments and Utilization Patterns

General

School Calendar and Plan
School Organisation Structures
Road Network of the Educational District
Career Information
Memos and Policies
Circular Advice
Lists of Official Contacts
Records of Official Visits
Particulars of School Development Society (SDS)
Particulars of Past Pupils' Association (PPA)

Figure 7

A Framework for Information Systems in the National Schools

The above framework incorporates five databases on students, staff, instruction / instruction support, finance / facilities, and general information. A database, according to Azarmsa (1991), is a collection of files. A file is a collection of records. A record is a collection of fields, and a field is a collection of characters. For easy manipulation of data, files in a database should have at least one field in common.

Of the hierarchical, network, and relational models available for structuring databases, the relational model best met the information demands of this project. This is a two-dimensional model with a number of rows and columns. As Azarmsa (1991) noted, a row of data in this model is equivalent to a record, and a column of data to a field. As in the hierarchical model, this model does not require the data to be accessed from top to bottom. This saves much time for the user. The relational model also does not require transactions to follow a standard preconceived path as in the network model. This model instead allows existing files to be merged, new files to be formed by extracting fields from different files, and records to be chosen on the basis of pre-established criteria, and wins over the other two models.

Data entry, which follows the identification of a suitable structural model, is a repetitious task which requires much time and effort. Database programs, according to Azarmsa (1991), provide the format and the power needed to create a database. The user is responsible for gathering and entering data as well as checking it for accuracy and completeness. Early in the data entry process, the user has to consider the size and the number of records to be accommodated in the student database. This database has to be planned carefully if records of those students leaving the school are to be kept active, at least, for some time.

With the establishment of databases, information retrieval for administrative decisions will commence. In this stage computers will be used to search, select and compare data, produce various lists (class, house) in alphabetic or any other preferred order, and to provide flexible query and reporting facilities. Moreover, the ability of the computer to extract data quickly from records, and to process information fast will facilitate annual returns to the Department of Education as well as statistical returns to the Ministry of Education.

Wordprocessing. Wordprocessing, simple in nature, is a good starting point for the use of microcomputers in school administration. This will be used in national schools for preparing lengthy reports, updating yearly documents (development plan, prospectus), developing standardized forms, and also for preparing and mail merging standard/personalized letters to parents and other concerned parties. The ability to typeset text directly from electronic media will also be used to improve the quality of school documents such as school magazines.

Electronic communications. Computers in national schools, along with a modem, communications software, telephone, and telecommunications facilities, pave the way for electronic communications. Electronic mail will be used in national schools for quick dissemination of information between locations and to reduce isolationism of schools covered by the project.

Student registration. Each year the national schools admit a large number of students. Computers will assist in handling the applications, processing of admission data, administration of admission tests, scheduling of interviews, and registration of successful candidates. The capability of the computer also will be utilized to keep track of the student flow within the school.

Distribution of free textbooks. National schools receive free textbooks from central authorities to be distributed among students. Computerization of this process will enable book labels and catalogue cards to be printed, book inventories to be maintained, and comprehensive status reports, that include statistical summaries, to be produced. The inventories will contain information on books such as numbers received, lent, damaged, lost, and in stock. The statistics maintained will also be useful at the end of each year to identify replacement requirements, and also to produce overdue notices for the borrowers who have failed to return their books.

School timetabling. School timetabling where various elements (students, teachers, curriculum, time, space) of the education programme need integration is found cumbersome in large national schools. To generate an optimum plan for the purpose and to reduce stress on the part of the timetabler, computers in these schools will be used in all three stages (planning, construction, and checking and printing) of the timetabling process. During the first stage of planning, computers will assist in a number of analyses in the areas of curriculum, staff, and facilities. In the constructing stage, the computers will find activities with the least amount of freedom for scheduling and place them suitably. In the third phase of checking, computer assistance will be obtained to run simulations mainly to determine the workability of the draft timetable as well as to print timetables for students, teachers, classes, and special rooms such as laboratories.

Cover for absent staff. Arranging cover for the classes of absent teachers is one regular and onerous task in national schools. To channel staff co-operation, the cover arrangements made have to be fair and just. Computers can be used in national schools to identify which teachers are absent for the day, which ones are free during each period, how many of them teach the same subject as those absent, and how much cover has already been allocated to these teachers. Once suitable personnel are identified for the purpose, computers will assist in the production of cover slips for the selected teachers as well as the cover timetable for the entire school.

Performance monitoring and progress reporting. Computers in national schools will be used to monitor performance of students as they wend their way through the system. Computerized student profiling will enable school personnel to identify students with special needs and suggest suitable remedial action for their development. With regard to progress reporting, computers will help teachers in the laborious task of developing the master marks sheet. The assistance of the computer also will be sought to analyze student marks, produce comprehensive summaries of subject statistics (average, standard deviation, rank), and to provide valuable diagnostic information to teachers. Moreover, computers in the national schools will assist in the preparation of accurate and informative report cards for the parents as well as auxiliary reports for administrative and counselling purposes. The teacher information needed for these reports will be compiled through short pre-defined statements or free text.

Public examination administration. Computers in national schools will be used to generate examination entries in formats required by the Department of Examinations. Student demographic data, previously entered, will allow quick compilation of the entry forms, when other needed data such as level of entry (first / repeat), fees due, and the like are available. Once all required entries have been settled, the computers will be used to obtain printouts for manual checking, and electronic communications will be used to transfer data to the relevant authorities.

The assistance of the computer also will be sought to speed up the preparation of results sheets, transfer results to relevant student records, and to notify students of their performance. Moreover, computers will assist in comparing results between departments as well as over time, and producing worthwhile statistical analyses. National, district, and school norm comparisons and graphics facilitated by the computer will enable the recipients of results to grasp better the implications of the data provided to them.

Transcript processing. Computers will be used to record assessment data pertaining to internal examinations and to state results for each child with comparisons related to attainment targets. The capability of the computer to retrieve data stored on tape will be used in national schools to satisfy requests of former students for transcript information.

Teacher evaluation. Computers will be used in the national schools to generate the needed forms for supervision and evaluation of teachers, to make diagnostic data available to the principals on the performance of each teacher, and to provide quick feedback to the individuals subjected to evaluation.

Attendance accounting. The national schools require a more precise system for monitoring and recording of student attendance. The use of computers for attendance accounting in these schools will enable attendance figures to be transferred automatically to student report cards, and accurate up-to-date attendance profiles to be submitted to concerned parties on request. The facility made available by the computer to differentiate between excused and unexcused absences as well as between whole day absences and class absences will also provide a wealth of useful information for decision makers. Although developed countries use computers themselves to provide quick notification to parents of at-risk students, the limited availability of personal telephones in the country under concern will force principals of national schools to be satisfied merely with written notification.

Student discipline. Computers will be used in national schools to keep records of disciplinary actions taken for different infractions, maintain student discipline files for future reference, and to generate letters to parents.

Guidance and counselling. The national schools will seek the assistance of the computer for career guidance where the students get an opportunity to discover more about themselves and about the world of work. In this context, the computers will be used to match student interests and skills with employer needs, and to identify students that meet specific requirements of different employers. Computers in the national schools will assist counselling by providing the counsellors with the information they need on problem students.

Management of the mid-day meal programme. National schools often depend on a contractor to provide the mid-day meal for their large student body. This requires systematic maintenance of records on school meals. Computers will be used to draw up specifications that indicate the number and type of meals required by the school, and to update these daily with information such as the number of meals delivered, number of meals consumed, and the number of meals paid for. The assistance of the computer also will be sought to produce weekly and monthly summaries.

Transportation scheduling. Fast computation allowed by the computer facilitates quick evaluation of a large number of alternative routes. Determining optimal routes thus, may reduce the number of busses needed for school service as well as the distance travelled by each bus, and bring about a substantial reduction in both gasoline and maintenance costs. The students, with reduced ride times and shorter distances to travel from their homes to the nearest bus stop, will also benefit from this effort.

Financial management. Financial systems according to the DENI (1989), assist schools to fulfil their statutory obligations with regard to finance, and allow them to monitor and control the use of available financial resources. Such systems in national schools will help track money owed to the school; generate receipts for all monies collected; authorize valid payments; provide accurate, up-to-date financial information on budgets, commitments and actual expenditures; and produce financial records and statements needed by schools to meet their statutory obligations.

Financial planning for any year requires expenditures pertaining to previous and current years to be compared against the budget profile. This requires the system to maintain two years of accounts at any one time. Facilities are also needed to look into individual items of expenditure mainly for exception reporting.

The general ledger, which provides a key report for evaluating the financial health of an organisation, according to Kearsley (1990), is a statement of how debits and credits, assets and liabilities, and incomes and expenses balance. Posting entries to the general ledger will be simple to the extent that all accounting functions (accounts payable/receivable, purchasing, inventory) that provide inputs to the ledger are automated. The national schools still channel most of their services and supplies through governing authorities. Accounts payable, therefore, is a minor consideration in national schools. These schools also can postpone computerized purchasing systems until such time that most organisations in the country begin to collect orders electronically.

Inventory control. The supply and circulation of material in schools, according to Bird (1986), varies from monitoring of stationery supplies to keeping track of expensive audio-visual equipment. Computers in national schools will record details pertaining to these items such as the supplier, order number, date of purchase, quantity, and cost. Such automated inventory systems provide a quick means to locate equipment, maintain supplies, and to track losses. Kearsley (1990) recommended a separate inventory of capital assets to facilitate systematic maintenance of land and buildings through additional accounting and reports.

Manpower and facilities planning. Computers will be used to project student enrolment as a first step in manpower and facilities planning. The projected enrolment figures will be used later to derive projections of other variables (teachers, classrooms, textbooks, equipment) that have an identifiable relationship with future student numbers. The speed with which calculations can be performed will be a major advantage in this endeavour. The ability of the computer to undertake what-if scenarios will also be of use.

Project planning and management. Computerized project management in national schools will serve a number of useful purposes in the areas of project planning and implementation. With regard to the former, computers will help sort project activities, identify the critical path and the slack time, enable "what-if" games that can improve efficiency in resource allocation, and generate project charts of improved legibility. In project implementation, the use of computers will help produce reports that illuminate the project status, ensure timely completion of all tasks pre-determined, and facilitate better direction and control.

Decision making. Computers in national schools will provide a powerful tool in analyzing decision problems, suggesting alternative solutions to these problems, and predicting consequences of different alternatives. The Decision Support Systems (DSS) intended to be used in this regard will first model decision problems by a process of decomposition and recomposition. These models will be integrated later with relevant databases to provide interactive decision support for administrators.

Calendaring and meeting scheduling. Computers in national schools will be used to find meeting times for staff groups established for various purposes. To be effective in this regard, the schools need to keep the calendar of each concerned person up-to-date. Although management of time yields important results, the national schools may not be able to use computers to schedule meetings that involve external personnel until such time when all concerned begin to use computers widely.

Some Problems Anticipated in the Computerization Process

The previous section provided a broad indication of the anticipated uses of the computer in the national schools. Utilizing the computer in these roles is not without problems. Applications such as attendance accounting require considerable time for entering and checking the data. The effective use of project management software demands prior knowledge of related concepts and methods. Applications like school timetabling, progress reporting, and bus routing inherently require a more personal method of analysis, which if neglected may create opposition and jeopardize the entire computerization effort. Transferring of statistical returns, examination entries, budgets, and the like to relevant authorities will also be problematic, unless a single coherent system can be shared across different levels of the educational hierarchy. Above all, the impossibility of envisaging all possible problems in advance requires a flexible solution that facilitates new applications emerging in response to newly developed needs.

Summary

Computers contribute to development only when used correctly. This requires managers to formulate their expectations of the new system clearly and to select applications that are appropriate in their own contexts. Goals, problems and characteristics of the organisation, user needs, and computing experiences of those both within and without the system are some factors to be considered in developing a framework for administrative computing. The framework so developed for the national schools incorporated seven subsystems that draw on four types of data. Simple applications, primarily operational and urgently needed by the national schools, were identified as implementation priorities.

Chapter 7

People Issues in Technology

Introduction

People are the most important resource for many forms of innovation. This is particularly true for technology-related innovations where humans control the use of technology. Since technology makes things possible and people make things happen (Barone, 1988), the productivity of the staff and the quality of the work they do become key factors in technological innovations. This centrality of people calls for effective management of human resources, which according to Aiyar (1989), deals with locating the right persons, placing them in the right jobs, training and retraining them for improved performance, and motivating them by providing for the right quality of job and security in employment. This chapter is intended to identify and analyze a host of issues in the areas of recruitment, retention, motivation and training.

Recruitment

As Coombs and Hallak (1987) noted, the education sector in many developing countries has been at a competitive disadvantage in recruiting and retaining able personnel. The situation is even worse for technology-related innovations in education that require specialist skills in a number of areas such as policy formulation, procurement, training, systems analysis and programming. In this background, filling the new positions created by the change becomes somewhat of a problem.

Who should be considered for the new positions? The education sector of many developing countries exhibits a severe scarcity of people with training and experience in technology. This situation calls for fresh recruitment irrespective of the large numbers already employed in education. Recruiting new staff enables the services of well qualified and professionally sound people who can bring new ideas to the innovation. Recruitment, however, involves additional costs. People with specialist skills are also scarce even outside the system, and according to Mawara (1986), cannot be attracted to education without a marked change in the system's salary structure. Furthermore, people drawn from outside fail to be effective when school personnel begin to see them as alien.

Selecting internal staff for the new positions provides schools with people who are closely acquainted with the organisational context, and therefore, are in a better position to deal with peers and organisational problems. This option bears little or no effect on salary-related costs, and saves time, effort, and finances associated with fresh recruitment. Although a motivator at the outset for in-school personnel, this can place excessive demands on the staff in the new positions and demoralize them in the longrun, particularly when the new appointees cannot be released from their original work. Depending merely on in-house talent also can prevent new thinking and retard the progress of the innovation.

Seeking the help of volunteers, yet another strategy for meeting the human resource needs of the innovation, provides no cost to the organisation. Postgate *et al* (1979), valued this strategy for its ability to bring organisational members in close contact with the general public. Volunteers for a newly developing field, however, are scarce.

The high demand for the skills of the few available also may not guarantee their services for a long period of time.

In the absence of local expertise, many developing countries undertaking technological innovations have sought the services of expatriate consultants. This strategy, according to Mawara (1986), is very high in terms of costs. The knowledge and skills transferred by such personnel also can be inappropriate to the local context. Above all, their tendency to hold on to jobs can demotivate the locals who acquire new skills.

How should new positions at school level be filled? The people co-ordinating this type of innovation, according to Gathercoal (1991), should be proactive rather than reactive, flexible rather than rigid, visible rather than secluded, and experimental and innovative rather than solid and unimaginative. For the success of the innovation, such people also should have a personalities that can encourage others to use computers, enthusiasm to devote their personal time to achieve mastery in computing, the persistence to learn the technicalities of operating a computer, and skills to use the keyboard properly. Many anomalies in the recruitment process, however, have led to the selection of people who lack special traits and skills much needed by the innovation.

Rushed selections, a common practice in change and innovation, often do not provide innovators adequate time to study the applicants closely to identify their suitability for the new positions. The need to have somebody in charge of the equipment as soon as it is installed, and also the rush to select teachers to attend the workshops planned for the would-be-co-ordinators, according to Makau (1989), leave the principals of schools with no time to observe the responses of staff to the innovation, or to assess the mastery the staff have acquired over technology.

In making selections for technology-related jobs, the junior staff usually get priority over seniors, and foreigners over locals. Some staff are appointed not because they professionally merit the position but because they are the favourites of those in authority. These shortcomings in the selection process do not allow the people ultimately appointed to win the respect and recognition of their peers, and according to Makau (1989), bring to the fore-front factionalism latent in schools and ethnic tensions observable in society. All this breeds jealousy, undermines staff unity, and destroys the school climate.

The district authorities, in many cases, have appointed school-level project co-ordinators. Such appointments depend greatly on paper qualifications, and pay little heed to special traits expected of the appointees. The principals may be more appropriate to undertake this task due to their ability to assess staff directly both in terms of competence and personality. Nevertheless, unavailability of replacements and the fear of losing good teachers to industry and business, once trained in computers, can prevent them from appointing the most capable to such positions.

Amidst the above problems, Makau (1989) saw the need for a gradual emergence of a project co-ordinator. Such an approach can eliminate many biases inherent in the selection process, and pave the way for people with appropriate qualities and skills. This option, however, fails to provide the project with a separate co-ordinator during its early stages, and may burden the principals of schools with an additional responsibility.

Retention

Trained manpower is usually unstable in developing countries. The mastery of the computer alone provides opportunities for school personnel to quit teaching for better jobs in business and industry. The new staff replacing the old, according to Makau (1989), do not have the experience or the training to participate successfully in a professionally delicate innovation midway through its implementation. If the innovators are to observe progress in the projects they launch with a rise in the level of expertise available to them, early action needs to be taken to minimise staff turnover.

How to retain qualified staff? The salaries for educators in developing countries, according to Palmer (1986) are low, $200 a month at best. The working conditions, promotional prospects, job status and job security, also low in education, makes it difficult for the system to retain qualified people particularly in a highly demanded field like technology. Many developing countries may not be in a position to afford external motivators, such as better salaries and benefits. These even when feasible are more helpful in attracting qualified staff rather than retaining them in service. Internal motivators such as interesting jobs with opportunities for growth and development, however, may provide a better means of retaining staff in the same employment.

Many developing countries conduct their teacher transfers independently of other important activities taking place in the system. This makes it very easy for the trained staff on whom the development of the innovation depends, to leave the system with minimal contribution to its success. The absence of precise agreements to retain trained staff in the same employment further aggravates the problem. Recruiting staff on a contract basis or making the innovators responsible for the transfer of the staff they have trained can guarantee the services of trained staff at least for a certain period of time. Nevertheless, binding staff to a particular job for lengthy periods of time can frustrate the affected members, particularly when they are no longer satisfied with their work assignments.

Staff Motivation and Morale

High staff motivation and morale are essential for the success of any change. Nevertheless, some characteristics of this particular innovation and of its leadership lead to employee resentment and resistance.

In western societies computers have proliferated in homes, industry and schools for over a decade. As a result many organisations in these societies are equipped today with a work culture that accepts technological change. The situation in developing countries, however, is different. The novelty of the innovation in these countries causes anxiety in staff, builds up resentment in them, and affects even very well laid out plans.

Most people find familiar modes of operation comforting and fear any change that may deprive them of this opportunity. This situation is particularly true for technology-related innovations that involve high levels of uncertainty and considerable time and effort for mastery. Except for a few organisational members in developing countries who identify personal goals (author books, change of career) as reasons for the adoption of technology, the others according to Makau (1986), are blinded by an ignorance of, and an anxiety over, change.

People who enjoy power in organisations do their best to protect it. This makes them resist any change that interacts with the power distribution of their organisations. Technological change takes over information that people with power once had in their custody, and makes them insecure. The senior staff in organisations also find it difficult to keep pace with the rapid advancements in technology whereas the junior staff adapts to the situation easily. The quick career advances the latter type of staff enjoys as a result, makes the senior staff jealous. Both insecurity and jealousy contributes to staff resistance and resentment.

Many innovations are also covert and depart considerably from existing rules and procedures. As Aiyar (1989) noted, the leadership does little to indicate to the followers its wholehearted backing for the change. The rush to implement according to McLaughlin (1987) *et al*, also does not allow user opinion to be sought and user consent to be established. Little attention paid to compensate the efforts of those undertaking extra duties further aggravates the problem.

How to overcome employee resistance to change? Training reduces staff anxiety and minimizes any purposeful action on the part of the staff to slow down the change process. Staff are eager to get involved in innovations that have no social or financial implications for them or require any drastic change in their life styles. This common fact makes it very important to plan staff development activities during the school day, and with no financial burden to the participants. Easy access to hardware and software also helps the staff to promote mastery with lower levels of stress and frustration. In view of the above, the teachers can be allowed to practise skills during school hours. This arrangement helps teachers to use their spare time in an intelligently productive way with no effect on their out-of-school activities. The success of this strategy, however, depends on the way the staff free periods are planned. Ad hoc distribution of free periods over the timetable is not helpful for the reason that it affects continuity in learning.

As another step in establishing staff morale, the change can be made explicit and geared as close as possible to centrally mandated instructions. This arrangement makes the staff more willing to accept the change. Establishing suitable communication systems encourages user participation in the innovation, and helps bring the change as close as possible to user needs. Moreover, good communication contributes to a work culture that helps users to establish consent, share benefits, and reduce insecurities. Such collaboration, on the one hand, enables the existing knowledge and experience to be exploited in full. On the other hand, it allows emotional support and reassurance to the novices. Focusing initially on a few worthwhile projects is also important. According to Emery (1984), the early successes this option makes possible can motivate the staff and lead to future successes. Recognising the services of all involved also encourage staff to contribute time and effort for the promotion of the innovation.

Training

The successful functioning of computers in schools needs a body of teachers who are skilled, confident, and innovative in the use of computers. User familiarity with hardware and software, a major factor in the success or failure of this type of innovation (Hawkridge *et al*, 1990; Heywood and Norman, 1988; Cox, Rhodes and Hall, 1987; DES, 1987; Hall and Rhodes,1986), requires great efforts in the direction of staff development. Training not only helps overcome staff resentment and resistance to change, but also enables more groups to have access to technology with more opportunity to control it. As Mawara (1986) noted, providing teachers with powerful tools without proper training is wasteful and can result in professional decay, demoralization, and inefficiency.

Professional development is a continuing process with endless needs for further training and updating. The recognition of this fact is particularly important in a field like technology that undergoes rapid growth and development. In spite of this situation, many developing countries over the years have given low priority to staff training. In-service training in these countries has been ad-hoc, poorly designed, and inadequately equipped, and therefore, low in terms of both quantity and quality. Developing countries also operate without a pool of technologically-oriented people who can cope with computers or a supporting base for technology in higher education. To be successful amidst these difficulties, the leaders of the innovation need to consider the following issues.

Who should be responsible for course design? For any training to be successful, it has to be planned carefully on the basis of relevant information. Nevertheless, the plans formulated rarely take into account the training programmes already available, or the needs and the wishes of the clients. The first, prohibits the planners from benefitting from the experiences of others. The second prevents adequate flexibility from being built into the programs.

When national bodies undertake the responsibility for course design, the innovation has more opportunity to be research-based, and to remain up-to-date with rapid developments in technology. This, however, deprives the users the ownership of the program, and makes them perceive the training as designed to tell them what they are supposed to do. Little opportunity to participate in planning also can make the users less enthusiastic to accept the change. Local bodies, when responsible for the task, provide less opportunity for research but more opportunity for user participation. The latter enables items relevant to the localities to be incorporated in the training and improves not only its flexibility but also its quality.

Should training in technology be separate from other training? In planning for training, attempts are made to balance the demand for technology-related training with training needed in other areas. The low priority given in such efforts to the former does not allow a separate course to be planned for computing. As Glen and Carrier (1986) noted, adding yet another topic to an already crowded course syllabus limits the time and attention that can be devoted to the area, and hinders successful integration of technology. Planning computer training as a separate course in the curriculum, on the other hand, provides ample opportunity to consider and adopt the latest developments in training design and implementation.

When should staff development start? Staff development for many innovative projects has often been under-budgeted and considered only after all other decisions have been made and implemented. In a sophisticated field like technology, the staff need a proper education to be functional at all. Low priority given to this aspect, according to the Commonwealth Secretariat (1987), can waste much of the investment made on the project.

Staff development can start early (before hardware and software are purchased), or late (after the purchase of hardware and software). The former enables the staff to be functional as soon as the equipment are purchased, and minimises the idle time of expensive equipment. This also prevents any under-budgeting of training due to high investments in technology. The latter helps the trainees to be selected on the basis of the enthusiasm they demonstrate in the use of newly purchased equipment. This also allows the staff completing the training immediate access to equipment to practise their newly acquired skills.

Who should conduct the training? People who undertake training, according to Makau (1989), have to be explainers, sharers, and teachers as part of their job. To pass on new skills to the trainees effectively, they have to be good communicators. They also need skills in drawing on the experiences and ideas of participants and in generating discussion among them.

Professionals in education can consider computers in education with a focus on important educational issues. Such personnel when channelled for training also provide little or no cost to the organisation. Being good communicators, they have no difficulty in passing the needed knowledge and skills to their clients, or in generating discussion among the trainees by drawing skilfully on their experiences. In the same field as those trained, they also find it easy to identify with the trainees and to win their credibility. Although good with people, the limited technical ability they may possess can downgrade the quality of the training they impart.

Professionals outside education, when involved in training, bring greater objectivity and a fresher point of view to educational issues under consideration. The services of such personnel, however, can be obtained only at a high cost. This type of consultant also may not be acquainted adequately with school needs, and may demonstrate low sensitivity to an academic culture. Moreover, as the NREL (1988) noted, such consultants have a tendency to care more for machines than for people, and to subordinate lay interests to technical standards. The poor teaching ability they may possess also makes them unsuitable as trainers. If organisational dependency is not to be increased, the innovators should make it a point to limit the services of external staff only to the short-term.

To be effective, the trainers need a blend in technical, behaviourial, and organisational skills. Trainers with all these skills are rare even in industrialized countries. This shortage is worse in the Third World, and according to Allotey (1986), reduces the quality of the training imparted. Channelling the services of a group consisting of educators and technical experts is a good way to address this issue. Although the differing interests of the two parties can cause problems in co-ordination, the groups' contribution to quality improvement in training has ample opportunity to override this disadvantage.

Who should be trained? The training programs planned often centre on the end-users who, for this type of innovation, comprise school principals, supervisory staff, teachers and support staff. Although this type of training enables the users to gain quick functionality and confidence, the tendency to overemphasize end-user training can neglect other important client groups such as policy makers, administrators, and project co-ordinators.

Any innovation requires a strong lead by policy makers. Nothing, according to Hawkridge *et al* (1990), is worse than a lead based on ignorance. Policy makers in developing countries neither have adequate exposure to policy and practice in other countries nor an awareness beyond basic computer literacy. If policy makers are to rethink education in ways that best serve the public interest, they need relevant training. Administrators, according to the Commonwealth Secretariat (1987), require training to demonstrate their interest in and support for the innovation. A good knowledge in technology helps them to inculcate conducive attitudes in those they lead. Training of co-ordinators, on the other hand, enables efficiencies in project management. This also helps pass on new messages effectively to the end-users, making it easy for them to integrate computers into their normal work.

How many should be trained? The usual tendency in many developing countries is to limit the number of staff trained. Although this is advantageous when the cost factor is considered, it has a number of shortcomings. First, this strategy does not allow any group, other than the end-users, to be considered for training. Training just one or two end-users in each organisation creates high dependence on a few people which may delay work or bring about total stoppage of work when the trained staff are absent, get transferred, or leave the system. Training more than one person, on the other hand, provides peer support for those trained and enables optimum utilization of the available expensive equipment.

On what bases should the end-user trainees be selected? As Aiyar (1989) noted, the senior workers who are about to retire are difficult to train. Not quick in seeing the value of a development, such people easily get lost in the general complexity of the technical operations they are supposed to master. The senior staff are also less flexible, and show reluctance to shed the manual practices they have been using over long years in the past. The reluctance they demonstrate to expose their ignorance of technology can also affect their enthusiasm to acquire new skills. Moreover, the fact that such persons occupy high positions in a school's salary structure can increase the salary-related costs of the project. The above situations create problems in administrative computing where the end users are much senior to those in instructional computing.

Selections also can be made from among those who have skills in computing. Such people, with low anxiety levels, are in a better position to benefit from training. People with prior exposure to computing generally belong to the younger age groups that are easier to train. Still in the lower ranks of the organisation, selecting such people also may have little impact on the salary costs of the project. Younger staff, however, lack experience in administration. Since this can rouse jealousy in the senior staff (Makau, 1986), the decision to train the younger staff in administrative computing has to be taken cautiously.

Trainees also can be selected on the basis of the knowledge they may have on the jobs to be computerized. This is particularly true for administrative computing where most of the jobs computerized are not new to the organisation. Identifying the manual performers of these jobs and selecting them for training eliminate the need for work reallocation, minimize role conflict, and simplify the training effort.

How should training be organised? The organisation of the training effort can be either centralised or decentralised. The decentralised approach provides different trainers for participants at different levels. In this sense it resembles the cascade approach described by Hawkridge *et al* (1990). Training here begins with the initiators setting out to train a group of trainers rather than the users themselves. These trainers then train the next level down in the cascade until the training is focused on the users themselves. The tendency of trainers at the intermediate levels to repeat the training they experienced previously with little regard to the needs of the clients, is one drawback of this method. Time limitations also may not allow the trainers at higher levels adequate opportunity to visit the training sessions conducted at lower levels. Irregular checking of standards as well as minimal feedback and support from higher levels can bring down the quality of the training imparted.

The second approach described by Hawkridge *et al* (1990), denotes characteristics of a centralized organisation. In this approach, the same set of trainers extend the training gradually to cover all participants in the project. Although this helps establish common purposes for all concerned and facilitates co-ordination, the longer time it takes to cover the full client group may be a problem.

The time of training. Training can be organised at different times of the school day, or during vacations, weekends or evenings. Selecting school hours for the training, according to Makau (1986), has little impact on social and family obligations of the trainees. Although this contributes positively to teacher participation in the process, the high demand it generates for training may require sound screening procedures for the selection of participants. Off-school hours may be inconvenient to both trainees and trainers but does nothing to disrupt the smooth functioning of schools. Drawing teachers away from schools during school hours is harmful particularly in developing countries where the schools operate with no substitutes.

The frequency of training. Training can be a one-time only affair or a continuous process. Initial training alone is disadvantageous because it does not allow the trainees to become familiar with hardware and software developments that occur on a continuing basis. Regular training, on the other hand, keeps the trainees up-to-date with the rapidly changing technology, and helps meet their needs for further training and updating. This type of training, however, drastically reduces the total number of persons that can be trained in a given time period.

The duration of training. The stiff competition faced by technology education for time and resources, often results in short (one to three days), introductory training sessions. Such training permits minimum learning, and therefore, is more suitable to familiarise the beginners. Short training also limits the time available for hands-on experience. Trainees completing this type of training often find it difficult to integrate computers into their day to day work, and to become fully operational. Training with a longer duration (a week or more) is wider in scope and more suitable for people with previous exposure to computing. This type of training, with more opportunities for advanced training, helps create the needed pool of human technological talent and prepares the system for greater independence. The longer duration of the training, however, can restrict the number of staff that can be trained in a given time period.

Where should the training be held? Lack of a suitable forum for training is a problem often encountered. To be effective, the place selected should be convenient to all concerned, and appropriate to the tasks at hand. A centralised location, when selected for training, may require the trainees to travel longer distances. Nevertheless, the possibility of preparing the location specifically for the task can provide the trainers with ready access to relevant software, teaching materials (video tapes, slides, audio cassettes, books), and problem solving support. Decentralized locations, on the other hand, can bring the training closer to the trainees. These sites, selected on a geographical basis, also enable the facilities already available to the system to be used at no additional cost to the project. Limitations, however, can exist in the infrastructure that can be made available for technical support. Such limitations can delay solutions to hardware and software problems, and frustrate the trainees.

What topics should the training cover? According to Wan and Li (1988), educational technology is an inter-disciplinary subject that incorporates knowledge from pedagogy, electronics, computer science, information science, and management science. Most of these areas are new to developing countries. The rapid rate of development in technology also makes it difficult for any training program planned in the area to remain up-to-date with the latest developments. Moreover, as Qi (1988) noted, there is no consensus among the stakeholders as to the purpose of the training. This situation also makes it difficult to come into agreement on its content.

The training is complex when its scope is considered. Nevertheless, many training programs very often limit themselves to technological aspects, and neglect other areas that are important when working in a technological environment. To be successful, the training programs designed have to be broad in scope and give coverage to a number of topics both technical and non-technical. The rationale underlying the change, the policies that guide action, and effective means of policy making, planning and budgeting for the change are some of the non-technical aspects that have to be covered. Although comprehensive training of the above nature provides ample opportunity for the trainees to accept the innovation, the impossibility of covering all these topics in detail may require different courses with different emphases for different client groups.

Very often the people who organise training assign inadequate time for hands-on experience. They pay undue emphasis to topics such as programming, the design and inner workings of machines, and the like. This situation makes the training imparted less comprehensible and highly theoretical. When imparting technical knowledge it is important to strike a balance between theory and practice. As Glenn and Carrier (1986) noted, hands-on experience also should not devote itself mainly to provide skills and confidence in running the machines. According to Persky (1990), this instead, should develop skills in trainees to use computers in their own work contexts.

What types of training should be considered? Training can take a variety of forms. To detect the suitability of each for technological innovations, a need exists to identify these, and analyze their strengths and weaknesses in detail.

General vs. specific training. The former is the case when all trainees receive the same training irrespective of their existing competencies. This type of training disrupts the progression in training for those with previous exposure, and makes them perceive the training as repetitive. The training, not geared to the specific needs of the participants, can also make them bored and uninterested in learning. General training, however, allows the same training material to be used across the entire client group, and saves both time and effort of trainers.

Staff development, according to Sparks (1983) cited in Glen and Carrier (1986), should begin by diagnosing the trainees' current level of expertise. Specific training, based on this premise, can bring the training as close as possible to the existing knowledge and skills of the participants. Such training also can be tied to the current work assignments of the learners, or tailor-made around their specific areas of interest.

This reduces stress, particularly in the older staff who are reluctant to embrace change, and makes all concerned active and participative in the training endeavour. The need to adapt the training material to match different needs of different client groups, however, can result in higher costs.

Formal vs. informal training. Formal training enables the trainees to grasp the required skills in a short time period but provides them with little opportunity for collegial interaction or for discussion of problems with the trainers. Informal training creates a training atmosphere within which the participants can freely express not only their doubts, uncertainties, and prejudices but also their insights and excitements. An informal exchange of ideas helps create new mental schema in trainees. This brings about fresh professional reflection and improves the performance of trainees in problem solving. Nevertheless, informal training lacks sequenced stages of development, which according to Makau (1986), can terrify and mystify the trainees.

Individualized vs. group training. Individualized training gives autonomy and decision making power to the learner. It also contributes to flexibility by enabling the individual to study at his or her own pace. Moreover, the opportunity this type of training enables to sequence learning from basic to advanced skills may facilitate progression in training and reduce the anxiety level of the trainee. Computers, a cost-effective tool in individualized training, enable quick remediation and reinforcement. Mills (1987) identified the peer group as the most credible source of information available to any trainee. Individualized training, however, neglects this and prevents sharing of information. Group training, on the other hand, fosters a spirit of collaborative learning. The opportunity this allows the participants to seek peer help and learn from knowledgeable colleagues are two other advantages.

Face-to-face vs. distance training. Training in a face-to-face environment uses both language and print modes to impart knowledge. More opportunity for peer support and immediacy of feedback are two strengths of the approach. Teachers, according to the Commonwealth Secretariat (1987), can receive some of their training at a distance as well. Distance education which is less expensive, allows learning mainly through printed media such as books and self-study packages. Although inadequate support at the time of learning can demotivate the participants and retard their progress, the approach may be of value when used to back-up face-to-face training.

What training methods to select? Training activities, according to the Commonwealth Secretariat (1987), should create an atmosphere where participants feel free to express doubts, uncertainties and prejudices, and share insights and excitement. The didactic method often used in training provides a situation contrary to this. The trainer in this method acts as the main source of knowledge and demonstrates, in detail, how particular programs could be used in one's work. This situation provides little opportunity for the participants to exchange ideas or to practise and give feedback on their endeavours. Furthermore, the high degree of "spoonfeeding" the method involves, makes the trainees more and more dependent on the trainer. This may induce the trainees to play a passive role and retard their creative ability. On the positive side, the didactic method provides minimal opportunity for trial and error and enables quick functionality and confidence in trainees.

The discovery method, used frequently in training, is based on the premise that the trainees will find out things for themselves through experimentation and consultation of manuals. The search for new knowledge, encouraged by the method, enables the trainees to experience the joy of learning as they progress. Although such experiences facilitate deep-seated and long-lasting internalisation of knowledge, the method may fail to work well with trainees who are used to clear professional guidance from central authorities.

The observation method allows participants to visit projects, with exemplary practices, and see what is actually happening in these. Awareness of effective practice makes trainees more cautious in confirming current methods and procedures. When compared to other methods where print and language modes dominate, the observation method makes internalisation of knowledge easier for the participants. The method, however, may be of limited use in developing countries where exemplary practices in technology are scarce.

Who should follow-up training? Many innovators do little to plan a follow-up component that takes into account feedback from the trained staff who are practising their newly acquired skills. The neglection of this has prevented the needs and problems of the end-users to be identified on an on-going basis, and remedial training to be arranged as appropriate.

The responsibility for follow-up usually rests with the trainers. Overburdened with training chores, such people have little time to engage in the task on a regular basis. Irregular follow-up support discourages users who encounter problems in the use of technology. Nevertheless, this type of follow-up provides firsthand information to trainers on training outcomes, and may lead to more effective training programs in future. The trainees also can be alert to their own needs and problems. In the hands of the trainees, the follow-up task becomes more regular and less costly. Although this arrangement provides better opportunities for in-school dissemination of training outcomes, the distance between the trainers and the trainees may hinder immediate support, and reduce user enthusiasm for experimentation and development.

Summary

People issues in technological innovations deal with recruitment, retention, motivation, and training of staff. The scarcity of qualified personnel and the tendency for rushed and biased selections cause difficulties in recruitment. Inadequate motivators, instability of trained manpower, and many anomalies in the teacher transfer process give rise to problems of retention. Many shortcomings of the leadership coupled with certain characteristics of the innovation affect motivation and morale of staff. Proper training of different client groups, however, can overcome most of the above problems. Nevertheless, for the training to be successful, the people planning for training have to address a number of issues. Some of these are related to the trainers and the trainees themselves. The content, approaches, types, and methods of training also have to be considered carefully if the innovators are to make the maximum of the training effort.

Chapter 8

Technological Issues

Introduction

The introduction of computers into schools requires two forms of technology, the software and the hardware. The software determines the functions performed by the computer. Depending on the programs loaded, the same computer can function as a wordprocessor, as an information source, or as a communication terminal. Since the success of computing depends on the way the above items are acquired, maintained and utilised, this chapter is intended to identify and analyze issues pertaining to hardware and software. The chapter begins by analyzing a number of issues common to the two areas above.

Issues common to Hardware and Software

Who should co-ordinate technological selection and acquisition? Technological acquisitions when poorly co-ordinated lead to situations that are costly and uneconomical. This is often the case when individual schools undertake the responsibility for hardware and software selection. When acting on their own, the schools tend to neglect systematic methods and get carried away by false perceptions. The end result here is unnecessary duplication of software and incompatible hardware. A central agency can provide more economic and professional merit in both product selection and acquisition. In the hands of such an agency, there is ample opportunity for systematic decisions on the basis of assessed needs and priorities. This arrangement also paves the way for proper evaluations prior to acquisition and may prevent schools from being burdened with inappropriate hardware and software. Moreover, central borrowing enables a wide variety of software for the users at a minimum cost. The software sharing promoted by the approach also facilitates optimum utilisation. Centralized co-ordination, however, can be problematic when the response time for requests for details about hardware and software is considered. The little chance the approach allows for user involvement in acquisition decisions also can undermine many good ideas the users may possess.

How to ensure procurement of the right technological product? The school population in most countries, according to Hebenstreit (1984), is about 25 percent of the total population. Although this implies a tremendous potential market for technological products, even developed countries have not yet succeeded in capturing an adequate portion of this market. With a few computers in each school, the manufacturers find it very difficult to sell their products at a price the schools can afford. The industry also has little understanding of the needs of education, and according to Hawkridge *et al* (1990), shows scant regard for the opinions of educators. This means that the market for technological products in education is determined by activity in other markets. To ensure procurement of the right technological product in a market of this nature, the educators contemplating acquisitions have to come to consensus about the rationale for the use of computers in schools. On the one hand, this makes the government more enthusiastic in subsidising the development. On the other hand, it helps establish a non-fragmented market specifically for educational technology with a good understanding of the needs of education and support for development.

Inviting tenders from vendors can also eliminate many inefficiencies in procurement. Adoption of this strategy makes educators more aware of the intricacies of the market situation, prepares them to detect trickery in selling, and prevents many mistakes that can occur due to any over-eagerness on their part. Pogrow (1985) identified the need for partial bidding. Letting the vendors bid on portions of the package, rather than on the package as a whole, enables the buyer to get the best deal on each type of product identified for purchase.

To avoid technological purchases that are regretted later, Ray and Davis (1991) saw the need to involve appropriate personnel in the selection process. Site administrators, representatives from parents and other community groups, computer-savvy people from local businesses and industry, and vendors themselves provide a few examples. The most useful dealers, according to Cheever *et al* (1986), are the independents not committed to any particular brand of product. A hands-on-trial prior to purchase also can minimize the risk of choosing a system that is not appropriate for the tasks at hand.

To ensure the correct technological product, the innovators should make it a point to select the dealers for their good service rather than for the good prices they offer. Many innovators, tempted by discounts, tend to buy their equipment mail order. The savings thus made, according to Cheever *et al* (1986), can be totally illusory if the future users need help in activities such as setting up the equipment or running the software.

Entering into a proper sales contract with the vendor is also important. Such a contract, according to Hollander (1986), should incorporate provisions for delivery, installation, training and maintenance as well as terms and conditions for all possible problems that the institution acquiring the products is likely to encounter. The need to specify these in the contract compels the educators to think clearly, not only about what they want the technology to do for them, but also about the problems they are likely to encounter both in acquisition and use of technological products. The schools also have to negotiate discounts and warranties in such contracts. Discounts can be obtained at the time of purchase or later when the upgraded versions of the purchased technology are released. A warranty provides a guarantee against the manufacturing flaws that cannot be detected prior to purchase or immediately after purchase. Entering into proper contracts facilitates future technological support for the schools. Such action also enables school personnel to assess penalties when the products they purchase fail to perform properly and to recoup costs when losses occur due to damage to hardware, software or data.

What decision sequence should be followed in technological acquisitions? The hardware and software, according to Hawkridge *et al* (1990), are so intimately linked in the operational sense that it is impossible to separate them from one another. Although it is the software that makes the hardware operational, the acquisition process often gives priority to hardware because it is more expensive than the software. Many institutions, according to Willis (1990), also make the mistake of fully funding their hardware at the outset itself with the thought that software funding and updating will naturally follow.

Neglecting aspects such as organisational goals, needs and problems, availability of educational software, and the reputation of manufacturers for support, according to the Commonwealth Secretariat (1987), has rendered many purchases unsuitable for education.

When hardware decisions precede software decisions, the selection of software depends on the hardware purchased. Although this decision sequence enables the hardware power to be realised in full, it limits the choice of software to a considerable extent. The software already developed and available provides important implications for what can be done and the ease with which it can be done. Since any incompatibility of a system with the software at hand can limit its use, it is the software that should take precedence in technological acquisitions. Selecting systems just because they have a lot of software at present can also have negative consequences. If the industry is in the process of moving to a new standard, the innovators may not be able to find new software for the system they purchase. A need, therefore, exists for a clear analysis of hardware trends as well.

Software decisions, however, cannot be taken without a clear understanding of the tasks to be computerized. This in turn calls for an assessment and analysis of organisational needs and problems. Such action improves user involvement in selection decisions and encourages interaction between producers and their eventual customers. The former can enhance the willingness of all concerned to accept the change. The latter can bring to light new software needs and allow the innovation to go beyond existing knowledge and experience.

How to get clues about existing technological products? The project leaders in developing countries are not equipped with the right education and training to make good hardware and software decisions. This problem, according to Mawara (1986), makes them acquire products that are weak in terms of growth possibility, serviceability, and compatibility. The same problem also encourages outside elements to influence the choice of equipment. The wishes of donor agencies, when considered in selecting hardware for educational purposes, tend to tie down the institutions to particular brands of computers often incompatible with the social, cultural, economic and infrastructural conditions of the country under concern. The limited support associated with this option can also increase the turnaround time of repairs. Pressures from teachers and parents when considered in hardware decisions lead to a diverse supply of hardware products that cause problems when it comes to integration. Deciding to buy a computer system because of outside pressure is not very helpful when the long-term growth of the project is considered. Such decisions instead have to be rational and based on information from a variety of sources.

The quantity of material published for computer users today is overwhelming. Many trade magazines, according to Ray and Davis (1991), provide practical and innovative ideas for using computers and application packages. Some publications are associated with specific computer equipment. Some focus specifically on certain software packages. The latter type of publications, usually in the form of catalogues from producers / distributors or directories, provides comprehensive listings of software that are available or under development. Selecting appropriate software from these lists, however, requires extensive reviews. Computing periodicals, according to Mandell and Mandell (1989), are useful in meeting this need.

Word of mouth, another means for identifying suitable technological products, provides a basis to determine the appropriateness of the products in educational settings. The long-term owners can be more objective in providing this information when compared to the new owners who are usually pleased with their choice, whatever the true merits of the case.

Visiting appropriate sites is another way of getting the needed clues. If the applications and facilities studied are to be within the means of the system under concern, the sites visited have to be similar to the target school system. Visiting a site similar in financial, administrative and enrolment variables but slightly larger also has merit. This allows the innovators to go beyond current needs and study the possibility for growth and expansion. Whatever the size of the site selected, the systems studied have to be those that have functioned beyond the initial stages of installation, and according to Ray and Davis (1991), have had adequate time to iron out problems of initial implementation.

The user groups are also sources of the needed clues. These, according to Cheever et al (1986), are organisations formed of people who use the same brand of computer or are interested in a particular computer application. By attending periodic meetings of such groups, the innovators can get firsthand information about the products that interest them.

The above sources, that provide a wealth of information about software and hardware, may be scarce in developing countries where technology is new. Although hiring a consultant can help overcome the problem, this however, has to be undertaken cautiously because undue dependence on established practice can generate a tendency for maintaining the status quo and prohibit thinking in new directions.

How to overcome the problem of technological obsolescence? Computers today are increasingly robust and last remarkably well. Nevertheless, rapid advances in technology do not allow institutions to use the hardware they purchase for its full lifetime. Governmental regulations for procurement also delay the acquisition process and make the institutions experience hardware obsolescence even before they install the new products. A distinction, therefore, needs to be made between the working life of equipment and the onset of obsolescence. The working life of hardware, according to the Commonwealth Secretariat (1987), is no more than five years. The onset of obsolescence compels these computers to be updated even when they are capable of fulfilling their primary function.

No standards is not the solution for the above problem of obsolescence. This statement is particularly true in developing countries where too many people are responsible for technological acquisitions, and foreign aid donors continue to favour their own products. The diverse models appearing in the country may not be compatible with one another due to non-standardisation of the operating system. Such models also may increase the portability problem of software. The presence of a variety of models also does not provide adequate incentives for commercial enterprises to enter the field and remain in it. Moreover, as Ray and Davis (1991) noted, the absence of standards calls for a large inventory of spare parts for timely after-sales service as well as training of service personnel on more than one type of machine. All of this, according to Emery (1984), can result in technical anarchy.

The question of software standardisation arises when countries venture into software development. Even with a standardized operating system, it is possible for software writers to program the machines in non-standard ways (Hawkridge *et al*, 1990). Unless strict discipline is enforced by the specification and enforcement of software production standards, there will be a high tendency for the use of non-standard programming techniques. Although such action speeds things up and makes the package more acceptable to the user, different programmers trying to break the rules in different ways, may require the original programmer to unravel his or her non-standard code whenever it comes to transferring the programs into different or more powerful machines.

Hardware standardisation requires that all schools use machines with the same operating system. With the establishment of such standards, the authorities can give preference to hardware that meet certain specifications, and exclude all other products from financial support. A single standard that is fixed also simplifies the task of selecting from a large variety of products. Moreover, it allows the equipment to be purchased at lower prices through bulk buying, facilitates co-ordination across units, and makes training, technical assistance and advice on technology much more cost effective. The availability of one particular standard, however, can limit the choice of hardware and bind the buyer to one manufacturer for life for upgrades and memory extensions (Hawkridge *et al*, 1990). Enforcement of standards also can prevent users from experimenting with software that run on new machines, discourage competition, and hinder upward compatibility of institutions.

To prevent obsolescence, caused as a result of fixed standards, Hawkridge *et al* (1990) proposed three approaches. Installing a second generation of computers in selected schools is the first of these. To avoid obsolescence of software, the new machines, equipped with the latest features of new technology, should be able to emulate the behaviour of older machines. The second approach is to have several different standards at any one time. This arrangement enables different kinds of computers to be purchased and distributed under some kind of control. According to Hawkridge *et al* (1990), the arrival of a new set of machines redistributes the older machines to application areas where they have been particularly successful. Cascading the machines thus from general use to specific use allows the users to learn on a number of machine types, and according to White and Rampy (1983), helps them understand the process rather than the machines themselves. The third approach is to let machines with different software standards to talk to one other through a common communications standard. This kind of working environment, according to Hawkridge *et al* (1990), is far in the future for many schools even in the industrialized nations.

Software Issues

What approaches to software acquisition need consideration? Software can be purchased outright or developed from scratch. The cost is a major barrier when it comes to outright purchase of software. This is particularly true in developing countries where the market for technology is limited. The software cost, according to Allotey (1986), is also on a rising trend and affects the purchasing power of many developing countries. Copyright laws further aggravate the problem by requiring multiple copies of the same program to be purchased.

A barrier is also observed when software purchases occur from a country where the language spoken is different from that of the importing country. When commands on the screen are in a foreign language, the users fail to see the machines as user-friendly. A difficulty also exists in handling input in national characters. Even though a language processing system with national characters can be installed to handle the situation, such systems, according to Wan and Li (1988), show low performance in terms of the number of key strokes needed for input and the display speed of output.

Software purchased outright is not necessarily tailor-made for the user. Much of this software, according to Willis (1990), is manufacturer specific, expensive, and not readily adaptable to the advancing technological systems or to the evolving needs of organisations. Such software, in other words, is static and prevents the user from interacting with the package to upgrade it for improved efficiency. Most imported software, according to Hebenstreit (1984), also carry cultural values and traditions of the country of origin. This cultural bias, a problem particularly in instructional computing, can hinder software transferability. The distance from the producers and their fears as to illegal copying also can prevent the buyers from previewing software prior to purchase. All this tends to burden schools with irrelevant software.

Developing software from scratch, another approach to software acquisition, is a lengthy process that involves high production time and cost. This activity, in many developing countries, is also still in its embryonic stage. The initiation of the task in education calls for the development of a core group of personnel. Although interaction among members of this group is important, inadequate funds to cover travel, subsistence and accommodation of those involved does not allow then to be brought together on a regular basis.

Many involved in programming consider the challenging part of software development as the writing of the program rather than definition of the objectives. This does not allow people with experience in education to be seconded into software development teams even when this consumes no additional cost to the project. Educators, as software developers, also find it difficult to master the use of a programming language. Already trained for a different function, they may show reluctance to spend time and effort to become computer experts. Finding off-duty hours or replacements for them also can be expensive. Software professionals, when hired for the task, find it difficult to understand the exact requirements of educators. With limited motivators to offer, the education system also may fail to attract outsiders with skills in software development.

A partnership established among the users and the technical staff, according to Bork *et al* (1987), however, can overcome some of the above problems.

Many developing countries lack the investment and the competence to undertake software development. Under such circumstances the general tendency is to use traditional program development tools. This action can result in poor quality programs. Programming languages, mostly in English, constitute another problem in software development. This situation compels people developing software to learn English before they venture into programming. Continuous engagement in the development of new products also can limit opportunities available for improving the existing products.

In a school context, the responsibility for the development of software usually rests with the staff and the students. Many education authorities in developed countries have faced problems when staff / students involved in these tasks begin to claim ownership of the software they have developed or modified during their regular employment / academic duties. The copyright in most countries belongs to the writer. When software is created under contract with the supervision, guidance, time and facilities of an organisation the copyright laws in these countries let the employer acquire the right for ownership. Such laws also consider translations, customizations and enhancements as derivative works rather than originals. In this context an individual adapting a program is not considered as its owner, unless according to Hollander (1986), a real break is visible in the connection between the original and the modification.

Intellectual property transcends international borders with ease. To govern intellectual property rights and to maintain business relationships and friendships, a need, therefore, exists for cooperation among the producing and purchasing countries. Under multilateral or bilateral agreements, the purchasing countries today provide foreign authors and their works copyright protection in the same way as it is provided in the author's country of origin (Salone, 1989). Most developing countries are also in the process of establishing their own copyright laws in accordance with those pioneering in the area of technology. To reduce liability related to ownership of educational software, the educationists in these countries, therefore, will have to take early action. Following their counterparts in the developed world, they can clarify ownership rights concerning software, and express these in employment contracts for staff and enrolment contracts for students.

Amidst the above problems associated with software acquisition and development, purchasing general purpose / generic software, and using it appropriately may be a better approach of meeting the software needs of organisations. This approach, which combines certain features of the other two approaches, is much more cost-effective. General-purpose systems, according to Bullough and Beatty (1987), perform a wide variety of functions given the appropriate instructions for guidance. In a similar vein, general purpose software such as wordprocessors, spreadsheets, graphic design tools and database generators are not developed exclusively for a particular application. For example, a spreadsheet program can be used across a range of applications such as budgeting, accounting, payroll administration, enrolment projections and grade reporting. According to Hawkridge et al (1990), generic software also provides open-ended, content-free tools that give the user the control of technology. As Thomson (1989) noted, this type of software does not have an inherently fixed style of use and provides the user an opportunity to define the application. All this makes the end product less culturally specific and enhances the value of generic software.

What considerations are important in evaluating software? A lot of time has to be invested in learning and using a package. A package that is inefficient, faulty or inappropriate, therefore, becomes very expensive even if it is free. The effective use of the computer also depends on the software selected. This selection, however, is an extensive undertaking when the software needed by schools for both instructional and administrative computing is considered. Although a good selection process requires adequate evaluation of software before making the final recommendation for purchase, the rush to launch the innovations often disregard this, and lead to many inefficiencies.

The quality of the software is one factor to be considered in software selection. User-friendliness, one facet of software quality, can distance the users from the "nuts and bolts" of computing, and draw them closer to the tasks they are supposed to accomplish. Good software also does not crash or provide incorrect results due to accidental wrong input. It has a good capability for internal error checking and indicating to the user the nature of the exact problem. Even software that has been carefully designed and written can have bugs in it. This is especially true for custom software. Some real drawbacks of software, according to Cheever et al (1986) will not reveal themselves until the package is fully laden with data and in constant use. To get started, a need also exists for short but intensive training on the package purchased. This calls for support from someone familiar with the software on a technical level. The evaluations planned, therefore, have to verify availability of support as well.

User manuals and reference manuals, according to Ray and Davis (1991), are a must for software products. User manuals are often tutorial in nature whereas reference manuals help in technical problems and installation. The usability of documentation is important in purchase decisions. Clear illustration and simple language reduce the dependency of the users on outside support, and make them functional even in the absence of training. Documentation in national languages, however, can be scarce in developing countries, and may require considerable time to be spent on translations. Documentation also lags behind software development, and often assumes user familiarity with the computer, which the beginners simply do not have. Such documentation provides little support to the users, who not only have to master the intellectual content of the manual, but also the ways of reconciling the material with the content and approaches of their work.

How to minimise liability in the use of software? The liability in software is related not only to its creation, but to its use as well. The relative ease with which even a novice can copy costly software has exposed many institutions to copyright infringement, and made the developers hesitant to supply preview copies to the users. Copying a protected computer program according to Hollander (1986), may be deemed plagiarism, just as copying any other intellectual work. Copyright laws enforced in many countries also preclude the loading of a disk on to more than one machine at the same time unless the license specifically permits this. Such restrictions generate a need to buy as many copies of software as there are computers and increase the cost of the project.

Developing software internally helps remove the above liability, but may not be fully worthwhile for the reason that it generates another liability related to ownership. Negotiating deals with software companies, a second strategy, allows multiple copies of software at a much lower cost. Collective bargaining may be of use particularly when coming into agreements with vendors. Fair use, according to Marks (1987), mitigates copyright provisions for a narrow range of functions determined on the basis of the purpose of use, the substantiality of use, the effect of use upon the work's market value, and the nature of the copyrighted work. Improving user awareness of such aspects can also minimise the above liability.

Hardware Issues

Should developing countries go for the latest technologies in the market? Rapid advances in technology frequently bring new machines into the market. This requires developing countries to decide whether they should go for the cheaper and faster machines of the industrialised world or be satisfied with the early machines of the past. The latest products of the developed world have their own advantages and disadvantages. On the positive side, the organisations purchasing such equipment get a chance to work with faster, cheaper, and more sophisticated machines. The disadvantages are mainly associated with the novelty of the products. This usually increases the lead time between placing of orders and receiving of equipment. When the equipment installed has not been widely used even in the countries of origin, the local suppliers may be of little help in rectifying the technical problems that begin to surface during implementation. Going for older products in the market, on the other hand, helps select a set of machines for which a wealth of experience is available. The intricacies of implementation are also well known for these products, and enable rectification of technical problems with no frustration or delay.

What approaches to computer acquisition should be considered? The hardware cost in developing countries, according to Hawkridge *et al* (1990), accounts for about one-third of the total cost, whereas this is only one-tenth in developed countries. This situation requires the schools to be cautious in identifying a suitable approach for initiating computer services. Purchase, lease and entering into a network arrangement are three such options identified by Bluhm (1987).

Outright purchase of computers facilitates not only special discounts, but also negotiation of software, peripherals and maintenance costs. Poor service, however, can be a problem when the vendor is not reliable. Trade-in, the only solution available in the event of depreciated equipment, may also limit the purchasing power of the organisation. Leasing, on the other hand, provides no additional cost to the organisation when the equipment purchased begins to depreciate. Further, this option provides a wider time range to complete payment and enables advantage to be taken of upgraded equipment. The existence of a penalty for cancelling the lease and having to pay maintenance costs whether needed or not, are two problems associated with leasing. Entering into a network arrangement helps schools to share equipment and software costs. This option usually brings about greater financial savings as well as more services than when operating independently. Standardisation, encouraged here, can simplify development of software as well as data reporting. Although networks help decision making to be shared across schools, they provide no guarantee for consensus in decision making, or for the security of data on which the decisions are based. The loss of local control and autonomy associated with this approach can also lead to centrally controlled systems.

What type of hardware should be encouraged? Developing countries newly entering the field of computing can go for micros, stick with mainframes, or link both types of computers in a single circuit with access to common peripherals. According to Bratlien (1989), the microcomputer offers freedom, flexibility and independent control. Although less sophisticated, this type of computer is cheap, and more valued for its capacity to aid school functions both efficiently and effectively. Mainframes, on the other hand, offer more power and security but require greater expertise for operation. Although expensive in terms of computer time, this type of equipment facilitates sharing of peripherals and enables higher efficiency.

Connectivity, the latest marketing slogan according to Hawkridge *et al* (1990), calls for the micro and mainframe environments to be joined together. Linked systems are cost-effective for the reason that they enable sharing of expensive peripherals and software. These also promote sharing of information, enable greater storage, and provide easy access to a variety of programs. Furthermore, the above systems hold print jobs electronically, and do not require the user to wait physically in line for the printer to be free. Moreover, linked systems facilitate centralised supervision of what is done at each work station as well as affiliation of schools to other educational institutions with facilities and expertise. The networking needed by linked systems, however, can be difficult particularly in the presence of different brands of computers. Such systems may also require extra technology such as telecommunications, mastery of new commands, and higher costs of installation and support. All this provides problems for developing countries that operate with restricted budgets. Network-compatible software is also scarce and expensive in developing countries. Moreover, lack of standards for networking may require each software program to be tailored to the demands of the system. Low speed can also be a problem when a number of users want to use the system simultaneously. Separated systems, on the other hand, are associated with low installation and maintenance costs, but the inability to share peripherals and data storage devices may require high investments on hardware. The limited opportunity to be in touch with large databases, or with other organisations through electronic mail or bulletin board services is another major limitation.

What considerations are important in evaluating hardware? Educational innovations in most developing countries attempt to cover as many students as possible in the system. In the presence of a social rationale of this nature, the cost becomes the final word for all acquisitions. The temptation to buy smaller, less powerful computers for schools just because they are less expensive has often proved to be a costly mistake.

As Coombs and Hallak (1987) correctly stated, a penny saved on capital investments is not always a penny earned.

According to the NREL (1988), limitations in equipment usually become apparent in memory, speed, storage space, colour, display width, resolution capability, letter quality, noise level, expandability, and compatibility. The durability of the keyboard and the steadiness of the screen image also have to be considered. The memory size and speed often determine the power of a computer. Limitations in power often cause the applications to be decided on the basis of machine capability rather than on user needs. Low powered machines, although lower in price, deny users access to many rewards and frustrate them once they pass the initial stage of learning. According to Hawkridge *et al* (1990), the speed of the computer although stunningly fast for the novice, may not be the same for the competent user. The users get frustrated when the machines are slow in responding to their commands. The memory, according to Ray and Davis (1991), is the temporary storage area that holds programs and data during processing. A large memory helps to accommodate the program file simultaneously with a large user file, and is of particular value to schools with high enrolment.

The possibility of upward expansion is an important consideration in hardware evaluation. Systems with such capability have the ability to upgrade with add-on modules within the basic system configuration. Expandability of hardware can be considered at the time of purchase or later. Considering this early requires high investments at a stage where the continuation of the innovation cannot be guaranteed. Postponing it to a later stage, on the other hand, can bring about the need for a complete system replacement.

What maintenance strategies to adopt? For proper functioning computers require on-going service and maintenance. Bluhm (1987) suggested three maintenance alternatives that can be adopted once the warranty expires. In the "wait and see" option one does not negotiate an extended warranty in the hope that breakdowns will be minimal. In the "play it safe" option the districts negotiate with a dealer through a vendor for an extended service contract, while in the "go it alone" option they institute a preventive maintenance program to keep their equipment working.

The "wait and see" option calls for local vendors whenever the equipment begin to malfunction. Buying technical expertise from the commercial sector, however, is expensive. Although the turnaround time for repair may be low, there is no guarantee for continuous technical support particularly in developing countries where the market for technological products is small and fragmented.

The "play it safe" option also represents a heavy demand on the computer budget. The extended service contract negotiated here calls for a monthly maintenance charge that approximates one percent of the total hardware cost. Shortcomings in the contracts negotiated also may not allow institutions to assess penalties when the items they purchase fail to perform properly. Some contracts fail to specify time limits for repair. Some fail to indicate the need for standbys in the event of equipment breakdown. Such limitations cause long delays when machines begin to malfunction. Similar problems can occur when installation fails to take place immediately after system acquisition. The warranty can expire during the delay between acquisition of equipment and testing it for correct operation, and according to Willis (1990), can prevent organisations from recouping the costs of malfunctioning equipment.

The preventive option not only keeps the equipment working with no serious breakdowns but also enables the system to initiate an in-house maintenance program with trained in-house maintenance staff. With this arrangement, maintenance becomes the responsibility of a central pool of technical experts. Maintenance, when centralized, not only guarantees continuous technical support but also helps achieve large benefits in terms of economies of scale. When schools undertake maintenance on an individual basis, repairs can be accomplished with less delay and minimum idle time of equipment, but limitations in space and expertise can create problems.

How to encourage optimum utilisation of hardware? Most computer installations in schools are used only during school hours, and according to Mawara (1986), go to sleep after a 12-hour day. With the unused capacity of the computer so high, under-utilization of hardware becomes an issue of immediate concern. For optimum utilization, the computers need to be housed in a centralized location. This arrangement enables easy access and makes the users more enthusiastic in using the equipment. Satisfactory arrangements are also needed with regard to scheduling. To reduce user frustration, the schedules developed should consider both the school and after school hours, and provide a fixed time for every user. The use of computers in many instances is restricted only to those trained. This does not allow an adequate number of staff to handle the equipment, and may affect functionality of the new systems particularly in the event of low user enthusiasm, high staff absenteeism and turnover. Keeping record of utilisation patterns, another option, helps detect low use early for corrective action.

The hardware purchased in many instances is more powerful than the software at hand, or incompatible with local languages, alphabets and electrical requirements. Any form of incompatibility can severely limit the potential use of the hardware purchased. To be operative, all parts of the computer have to be consistent with the requirements of the basic operating system. Moreover, as Allotey (1986) noted, the hardware has to be compatible with the software available as well as with the social, cultural and infrastructural conditions of the local environment in which it is supposed to operate.

Some schools, according to Hawkridge *et al* (1990), are over cautious in handling expensive equipment. This situation is most common in schools that operate with one computer. The careful protection and nurturing that usually goes into the only machine available may make it remote and irrelevant in the eyes of teachers, and lead to a situation where the machine remains virtually untouched.

Students often log on to computers to do mischief or damage. As Hollander (1986) noted, breaking the access code of a computer to alter data or to plagiarize some information stored therein is a fairly common activity in schools. Such offenses do damage, not only to data and people, but to hardware and software as well. The hardware can also be subjected to unauthorized use of varying types and degrees. The teachers may want to engage in outside research or business using the institutional computing facilities. The typists may want to provide typing services to staff outside normal working hours. The students may want to develop extra skills during free periods. To increase the availability of computers for use, the institutions going into computing, therefore, need to determine punitive responses to computer abuse and make these known to all concerned. A similar indication as to the type and amount of personal use allowed of the institution's computing facilities can improve the availability of computers for authorized use.

Summary

The two forms of technology, the hardware and the software, are intimately linked. For optimum results, software decisions should precede hardware decisions in technological acquisitions. Standardisation, although a sensible policy to adopt, can give rise to technological obsolescence. To control this, equipment can be cascaded from general use to specific use as new technology becomes available. The generic software that gives the user the control of technology is a good way to meet the administrative software needs of schools. Hardware can be purchased outright, leased, or acquired by entering into a network arrangement. When prevention becomes the strategy for maintenance, there is opportunity for an in-house maintenance program.

Chapter 9

Fiscal and Managerial Issues

Introduction

A host of fiscal and managerial issues complicates the task of introducing computers for school administration. Financial issues, according to Friend (1985), show a close relationship to all other constraints. Managerial issues deal with the four basic aspects of management - planning, organising, directing and control. Since development is an important management concern, issues in the area of research and development will also be considered in this Chapter.

Fiscal Issues

What sources of funding should be considered? Since the 1970's a severe decline occurred in the public provision of education in most developing countries. This worsened in the 1980's with damaging effects on education. The opportunity cost of the project, or the cost of not using the resources for another more urgent need, is high in developing countries where most schools have not yet met their basic needs. The short-term results that count most in the struggle for funds are also difficult to detect in complex innovations like this. Given this background, generating funds for the project becomes a major concern.

The public budget, the most common source of funding for this type of innovation, usually covers only a percentage of the total cost. This option, with no obligation for repayment, allows more opportunities for a proportionate distribution of technology across schools, but may limit the freedom available to school personnel in technology related decisions. As Goldstein (1987) noted, government appropriations are associated with slow capital financing processes that have often made the equipment obsolete even before installation. The government laws also do not allow the use of state funded equipment for anything other than public purposes, and obviate many attractive ways of supporting the on-going costs.

Attempts have been made to compensate for the decline in public expenditure by increasing the parental and community share of funds. Tuition fees, when set at an appropriate level, guarantee a part of the needed revenue. The need to charge both the rich and the poor alike, however, may be a problem for less well-to-do parents. Charging a special fee from the junior students can be more appropriate when the longer time they can benefit from the innovation is considered, but this disregards the senior students who immediately benefit from the innovation. Charging just one category of students also may not be sufficient to meet the massive resource needs of the project. Instituting a student registration fee, according to Chapman (1991), enables funds for the innovation to be set aside from the authorized annual collection. Student enrolment figures that form the basis for this apportionment, however, can create a financial disincentive for accurate reporting of education data.

Donations, another source of income, can be in cash or kind. The novelty of the innovation, however, limits aid that is in kind. The items donated also can be obsolete or incompatible with others already available. When businesses and industries in the surroundings are considered as funding sources, they tend to deflect the long-range goals of schools. International contributions are of particular value to developing countries that function with scarce foreign exchange. This, although a common source of funding for technological innovations, may not cover anything beyond the initial expenses of the project.

What financing strategies to adopt? Computing, according to Hurley (1988), is too pervasive and expensive to be funded merely from resources at the institutional level. This situation generates a need to identify and adopt a financing strategy that is recognisable, equitable and consistent.

Partnerships, according to Hurley (1988), can be either internal or external. Internal partnerships can consolidate basic services such as printing, or bring about institution-wide site licenses to share software costs. Joint ventures with other organisations encourage the merging of public and private financial resources and broaden the use of available facilities.

The NREL (1988) proposed two financing alternatives, cost sharing and cost saving. When the former is in effect, the schools begin to depend on a number of sources for the meeting of their financial needs. This can make the schools neglect many internal partnerships that can be very productive. Cost sharing with those who are well disposed is not without problems. Any such generosity, according to Makau (1989), has strings beyond moral goodwill, and according to Hollander (1986), has a high likelihood of deflecting the schools from their overall long-range goals.

Postgate *et al* (1979) discussed a number of cost savers such as cheaper input (lower rates of pay to staff), controlled output, use of facilities and services paid for by other agencies, and use of volunteers. According to the NREL (1988), donations can be solicited from computer corporations, mass purchase plans can be utilized to get the best prices available, and lease-purchase options can be arranged to reduce the initial hardware costs. Such attempts, either with no cost to the project or at a reduced cost, depend heavily on voluntary help or on the use of borrowed facilities. Cost savers, however, need to be adopted cautiously for the drastic impact they can generate on the quality of the innovation. Hidden costs associated with this approach can appear in school budgets at a later stage.

Hebenstreit (1986) defined matched funding as an approach where the schools fund the project with an amount equal to that given by central authorities. The use of this approach contributes to the continuation of the innovation even beyond public funding, and supports institutionalisation.

Long-term debt allows the borrower the immediate benefit of the principal. With this financing strategy, the amount that needs to be budgeted annually to service interest payments and to amortize the principal is relatively small. Any obligation to service a debt, however, can strain an institution's resource base. Less well-off institutions also find it difficult to identify a revenue stream for the servicing of long-term debt. As Goldstein (1987) noted, such institutions have to incur significant costs to obtain credit support. This can generate a need for pooled debt financing where obligations of a number of institutions are pooled together to satisfy investor confidence.

Leasing, another financial strategy, facilitates acquisition of costly equipment particularly when government regulations limit debt financing or when an institution lacks credit worthiness to acquire loans. This option, according to Goldstein (1987), not only allows the payment for the equipment to be phased in but also enables it to be considered as an operating expense. Depending on the type of lease entered into, the lessee also gains a number of rights such as to retain the title to the equipment, to purchase the equipment at the expiration of the lease, or to get the equipment serviced through the lessor. Moreover, the ability to cancel the lease on a year to year basis protects institutions from making continuous payments on obsolete equipment. The high interest charge of a leasing contract, however, can be a problem.

What considerations are important in budgeting? According to the NREL (1988), a number of issues have to be considered in developing a budget structure. The percentage of the total operating educational budget to be allocated for the innovation, the components over which this money is to be split, the percentage to be allocated to each component, and the way in which these proportions are to be changed as the programme develops are some important concerns.

Technological innovations are very often planned as separate entities isolated from other demands on the system. This situation provides little opportunity to identify the alternatives to spending on computer-based school administration. Such alternatives, that can lie in another area within the education sector or in a vital development program outside education, when not identified, prevent spending from being targeted to the greatest effect. To eliminate the above problem, the NREL (1988) saw the need to consider the opportunity cost of the project early in financial planning.

Although careful costing is a prerequisite for good budgets, many technology projects have paid little heed to this. Unclear project goals and many inadequacies in the cost data are two reasons for this oversight. The former prevents the detection of cost elements. The latter creates problems in assessing the associated costs. In the absence of proper costing, a tendency exists to neglect future needs of the project and to plan over and above the available resources. These limit the cost-effectiveness of the new system to the short-term and makes it impossible for the innovation to be extended beyond its preliminary stage.

Innovators often make use of free resources. Any free resource, according to Coombs and Hallak (1987), has an economic value that can appear in education budgets at a later stage. To eliminate financial difficulties when such costs turn out to be real, it is important for the budgets to keep track of these resources as well as their associated costs.

Technological innovations impose two separate sets of financial burdens on institutions: the initial cost of acquiring the needed resources, and the on-going cost of operation. The initial costs are mainly for hardware and software acquisition, staffing, and for site preparation. The on-going costs are for staff training, hardware maintenance, technological updating, supplies, periodical subscriptions, insurance, and contingencies.

The innovators planning for new technologies, according to Goldstein and Woolsey (1987), give undue significance to hardware costs. Although they assume the added operating cost of technically advanced systems to be relatively minor, Coombs and Hallak (1987) noted this to be as high as the initial capital cost. Comparing this situation to a new-born babe, Emery (1984: p.9) declared that "it is not the initial cost but the upkeep that counts." In spite of this knowledge, most institutions significantly under-budget non-hardware resources and end up hardware rich and service poor. The situation gets worse when the staff becomes computer literate and begins to demand for a wide variety of software and support services.

What approaches to fund allocation should be considered? Funding determines the level of service the schools can offer. To prevent many schools from becoming the "have nots" of the society, White and Rampy (1983) saw the need to allocate the limited resources available to the project appropriately.

Financial arrangements in many instances are centrally handled. This ensures allocation of resources on the criteria of quality, centrality of demand, and realization of economies in the areas of purchasing, staffing and equipment usage. The centralized arrangement, however, provides meagre opportunity to utilise the funds approved by central authorities for the meeting of locally perceived needs. Financial arrangements, when decentralized, can take two forms. The first is to give each regional authority a budget to provide the needed services to the schools that come under its jurisdiction. The other is to let the schools have their own budgets so that they can pay for their own services and products. In the first approach, it is the schools that are funded rather than the school persons who undertake the projects. The budgets in this arrangement go untied to any unit of productivity. Letting schools have their own budgets, enables the funds to be utilised for the meeting of perceived school needs. Although this approach encourages school personnel to undertake projects and keeps them active and motivated, the severe imbalance in spending it can generate across schools, can be a problem.

Managerial Issues

What skills should managers cultivate? Developing countries with limited resources do not enjoy a reputation as leaders in technology. Even as followers, they have ample opportunity to benefit from the efforts of others pioneering in the area. Nevertheless, most of these countries hesitate to invest effort and funds to keep up with technology. Some countries even use their inability to stay at the forefront as an excuse for inaction. The schools in developing countries also have problems in getting the type of administrative support the success of the innovation requires. Unrealized promises of the past, according to Emery (1984), have made it difficult to convince the top officials of the scope of computing services necessary for performance improvement. With many suspicions over technology, these people are either overcautious in taking the initial step or continue to be silent recipients of new technology. Both of these stances retard development, the first, by stabilizing the status quo, and the second, by inhibiting inquiry.

As Gathercoal (1991) noted, the leaders are also more resistors than amplifiers of change. Such leaders, according to Hurley (1988), consider the system as a cost rather than an asset. With little understanding of the purpose of the change, its potential, and the associated problems, it is also not easy to sustain the interest and involvement of these leaders. The same weakness also does not allow the leadership to elevate the motives, values and goals of the followers, or to create a climate conducive for implementation.

The successful integration of new technology, according to Aiyar (1989), calls for managerial skills of a higher order. Managers need such skills to adjust to new methods of work and supervision needed by the innovation. Moreover, higher order skills increase the commitment and aspiration level of those in leadership positions along with the enthusiasm they demonstrate for change, and help eliminate most of the problems discussed earlier.

How to improve policy making at school level? Policy formulation for the adoption and use of computers is an important task that initiates planning for the change. Nevertheless, the principals who implement change at the school level show reluctance to formulate policy for a variety of reasons. Many planned innovations, according to Makau (1989), are not in agreement with centrally mandated instructions. This requires the principals implementing the change to depart considerably from the rigid rules set out for them by higher authorities. Covert indications of leaders as to the innovation coupled with the limited support available from high level individuals also cultivate fear in principals and make them less enthusiastic in policy formulation. Some in administration also have limited knowledge and skills in the area of policy making. To motivate all administrators in the required direction, a need, therefore, exists to formulate clear guidelines as to the role of the administrator in the proposed change, and to incorporate policy making as a special topic in the training programmes planned for this category of personnel.

What planning approaches to adopt? Planning, according to Hurley (1988), is an essential process that enables institutions to take advantage of opportunities and exploit strengths. Adequate planning takes time and hard work, yet it is a small investment when the ramifications of foregoing it are considered. Although good planning is a prerequisite for successful implementation, innovations very often are poorly planned. Uncertainty looms as a result, and leads to frustration.

High expenses, ambiguities and uncertainties make planning for computers difficult, and generates a need for a suitable approach for planning. The "no plan" approach, according to Bluhm (1987), is common when uncertainty exists. The linear planning approach sets objectives, selects procedures, identifies time lines, and determines evaluation procedures in a sequential manner. The contingency planning approach brings to light unforeseen events that can affect decision making. When the "no-plan" approach is the norm, the acquisition of computers results from the initiative of vendors rather than through proper needs assessments. This leads to the purchase of equipment which may not be compatible, dysfunctional due to non-availability of appropriate software, and incapable of meeting user demands. The linear planning approach is workable only if the events have a high probability of occurrence. This may not be suitable for technology-related innovations that function at a high level of uncertainty. Contingency planning recognises the possibility of unforeseen events and helps deal with uncertainties. The incremental, ongoing, adaptive and self-corrective nature of this approach makes it well suited for technological innovations.

How to make planning more effective? It is essential to establish a strong link between institutional strategic planning and planning for technology. Although the former has to precede the latter, the technology plans drawn up in many instances do not emanate from the strategic plan of the organisation or take cognizance of the realities of organisational dynamics. According to Barone (1988), computers should not become strategic objectives in themselves, but rather vehicles in achieving institutional strategic objectives. To be in line with the above premise, school-wide goals have to be reviewed in the light of outstanding computing needs.

In planning, a need also exists to pay attention to other plans formulated both within and without education. This helps identify alternatives to spending on the proposed innovation and target spending to the greatest effect. An awareness of activities earmarked for implementation also prevents duplication of effort and leads to balanced growth.

Effectiveness, according to Hurley (1988), is a result-oriented concept with emphasis on doing the right things. Efficiency, on the other hand, is a cost-oriented concept with emphasis on doing things right. There is nothing quite so useless as doing with great efficiency, the things which should not be done at all. A plan, therefore, should support institutional goals and be effective first. Efficiency can be judged subsequently in the context of operational realities.

Rapidly developing technologies encourage every educator to be a futurist capable of looking beyond short-term needs. Nevertheless, much of the efforts of planners are short-term in nature, and relate to current issues and existing resources. When medium and long-term technological plans do not precede initial equipment commitments, the core capabilities needed for future expansion gets neglected. This situation, according to Willis (1990), can lead to a wholesale abandonment of the change, no matter how effectively the plans meet the short-term needs of the innovation. An on-going planning approach, that includes a long-range plan along with short-term review processes, allows planners to look beyond current issues and existing resources, ensures currency in the process, and avoids later frustrations.

Very often the time assigned for planning is inadequate. The rush for implementation does not allow either the growth targets or the resource needs of the project to be assessed realistically. The end result is an overly optimistic plan that neglects many limitations in funding, space, and human resources. Assigning adequate time for planning provides opportunity for pre-investment feasibility studies, and prevents planning over and above available resources.

Most problems in implementation, according to Bork *et al* (1987), have their origin in a short preparatory period with a very strict time schedule. Implementation begins before the parties involved have had time for necessary preparations like negotiations, installation of equipment, staffing, and development of competence. To reduce chaos in implementation preparation also needs adequate time.

The concept of information technology envisages fundamental departures from known practices in schools. This makes it desirable to execute the proposed innovation first on a pilot basis. A pilot development phase, according to Zanuttini (1982), allows a gradual approach for the establishment of structures and training of people. The rush to implement computers in schools with no pilot phase can affect programme quality. As Friend (1985) noted, this also can create an adverse reaction that sets back further development. Extending the pilot stage for long is also not appropriate for it can frustrate those involved.

Mills (1987) saw the need for technology to creep into programmes along lines of minimum resistance. Selective implementation requires the areas that have greater affinity for technology to be identified and implemented first. These are aspects of technology which can be implemented with least disruption to normal practice. Opportunities provided for selective implementation makes it easy to channel the support of the staff later in other areas of less natural affinity. Involving supervisory staff at different levels of the hierarchy also enables ideas that work to be incorporated in the plans.

Where should the project office be housed? Projects can be housed either in an independent location or in the premises of one project school. The first option allows all schools covered by the project an equal opportunity to interact with the project personnel. This also makes it easy for the staff to be impartial. Housing the project in the premises of one project school can provide project staff ready access to first hand information on implementation. Such feedback facilitates research and experimentation, and may be of value to the innovation particularly in its early stages.

What organisational model to select? The project can be organised on a centrally controlled model for development, or alternatively, on a completely decentralized model. In the centralised, top-down approach, all decisions are taken at the top. The decentralised or grass-roots approach permits individual schools to take the initiative as to when and how computers should be introduced.

The centralised model provides the needed initial push and ensures quality and continuity of the innovation. The model also helps eliminate duplication of effort, brings down costs through economies of scale, and discourages diverse products through proper standardisation. As Postgate *et al* (1979) noted, this top-down model extends the capacity to receive, to learn and to appreciate, but devalues the human element to a great extent. The longer feedback loop here also does not encourage democratic discussion and hinders change in those led. The model looks upon the leaders as sources of authority. This makes people in lower ranks to wait to be told everything and prevents collaborative interaction between superiors and subordinates. The model further reinforces bureaucracy which not only slows down and complicates acquisition and installation plans but also hinders experimentation, creativity and flexibility the innovation much needs for its success.

The progress of the innovation, according to Coombs and Hallak (1987), demands a flexible, open system of management which can respond to local conditions and needs and encourage the participation of interested people at all levels. The decentralised model that serves most of the above purposes, according to Postgate *et al* (1979), extends the opportunity not only to receive but also to give by expression and action. This type of model brings about a fertile ground for within school professional discussion and dissemination of innovative ideas. With this model goals and rewards are determined through group participation, communication takes place in all directions - up, down and sideways, and support and control become shared functions with the ability to generate high user motivation and morale. This model, however, is not without problems. According to Bork *et al* (1986), the schools on their own may not have the necessary competence to provide the concerted effort that important functions such as training and software evaluation demand. Moreover, most managers in developing countries have worked for long in strict bureaucratic systems, and as a result may not be ready to embrace, or at least talk positively of, participative management techniques.

The distributed model, a third approach, according to Bluhm (1987), combines the resources of the centre with contributions from the building level. This model, also called the shared model, gives freedom to individual schools with central measures extended to ensure quality and continuation of the innovation. Advisory committees play a prominent role in the use of this model. In establishing such committees, it is absolutely imperative to consider people with power. Support from such people alone may not suffice. Individual school administrators and staffs, according to Cheever *et al* (1986), can thwart or at least delay most mandates from the top, so their support is also needed. To overcome the above problems and to obtain a broad base of support, the committees formed should incorporate a wide variety of personnel such as administrators, different types of school personnel, parents and representatives from the general public.

Thomas (1989) noted a change in the locus of decision making with a change in the type of technology used. With the advent of the personal computer, the centralised control no longer remained the norm. The locus of decision making is likely to move upwards again as complex and expensive technologies get incorporated into education. This observation has a high likelihood of making the shared approach the dominant pattern in future computer projects. The shared approach provides more opportunities for user opinion and improves communication within the system. Control from the top also reduces technological anarchy. Committees, however, can stifle action as readily as they can take it. This situation requires caution in nominating people for the committees.

How should computing be organised in schools? Computing and library services are related in the sense that both are information repositories, the first in terms of programs and data bases, and the second in terms of written material. Although management of information is central to the functioning of any institution, most organisations do not have a single organisation for all information services including computing, telecommunications, printing, and publications. Many institutions have also separated academic and administrative computing both physically and administratively. A lack of convergence between these areas, that have more or less similar resource needs, inhibits many of the advantages associated with joint operations. First, this situation does not enable hardware, software, and networks to be shared, and prevents many economies of scale. Second, it does not allow one single individual to be in charge of the overall computing aspect. The latter can bring about a severe imbalance in funding as well as duplication of effort. As Thomas (1988) pointed out, integration does not allow empire building by any one of the two factions. Nevertheless, the wide variation that exists in the interests, needs and perspectives of the two groups may not make this always possible. According to Emery (1984), the boundary between administrative and instructional computing, however, can get blurred when teachers begin to use the computer as a tool for classroom administration.

How should computers in schools be housed? The schools in developing countries can afford just a few computers. This generates a need to share the available equipment equitably among different users. Since the place where the schools locate their computers has an impact on how equipment is used, a decision has to be made between a centralised location and a portable laboratory.

A centralized location for computers requires adequate hardware and a higher frequency of use to be effective. The place selected for the housing of equipment also has to be convenient, secure, and quiet, and be equipped with appropriate infrastructure. A fixed location with the above characteristics allows easy access to all authorized users, enables them to work with minimal distraction, and helps establish arrangements that protect the equipment from dust, high temperature, excess humidity and power interruptions. Housing computers likewise, also enables the staff responsible for the laboratory to become specialists in the technology used. This situation not only facilitates the development of other staff but also provides better opportunities for efficient management and maintenance of facilities. Ready support from knowledgeable personnel and improved dependability of equipment, another outcome, help minimise user frustration and improve use both in terms of extent and variety. One department having the responsibility for the laboratory, however, may not be favourable. This can develop a territorial situation and reduce the use of expensive equipment. With central housing of equipment, the people planning to use the facilities also have to adjust their schedules to suit that of the central laboratory.

A portable laboratory, on the other hand, provides computer access to people at different sites. The lack of a fixed location for the equipment has a number of drawbacks. First, it demands trolleys for equipment transportation. Second, it prevents the organisation from many advantages of networking. The need to move equipment can also create difficulty in using the installation as one unit. Constant plugging and unplugging, associated with this situation, enhance the potential for equipment breakdown.

How to make security planning more effective? Hardware, software and data are all liable to accidental or deliberate misuse. Hardware needs precautions against unauthorised use, theft and vandalism. With regard to software, both the operating system and the application programs need protection. Any damage to the former can result in a complete shut down of the system while damage to the latter can suspend the services rendered. Privacy and confidentiality of school records is the third aspect to be considered in security planning. Students may want their academic records to be accessed only by authorized persons. Staff members may want to protect the privacy of their personal information stored in the computer. Although security planning is important, any attempt to overemphasize this aspect can deny users the privilege of easy access.

The literature suggests a number of strategies for the protection of privacy and confidentiality of school records. Maintaining separate computers for separate purposes is one such strategy. Introducing software access control systems, another strategy, helps control access both in terms of people reaching the data as well as the fields they access. Such systems also maintain a log of all use. No security system will be effective unless the people involved accept it and value it. This compels the management to channel the co-operation of all concerned. Security systems also have to be changed from time to time to prevent people from becoming familiar with them. The security of hardware, software, and the data also can be enhanced by determining the punitive response of the school to computer abuse and indicating it clearly in school policies and handbooks. This strategy helps maintain suitable standards for student behaviour. Insurance coverage also helps manage risks in the event of damage to hardware, software and the data.

What information to collect? An active and responsive information service about the innovation provides information on the past, present and the likely future of the innovation, and helps all concerned exploit existing knowledge and experience regarding the change. Information systems established for technology-related innovations can supply information on policy, contact personnel, training opportunities, forthcoming meetings, hardware and software reviews, and software available and under development. Such information not only facilitates collaboration across schools already involved in the project but also enables others outside the project to assess the suitability of the innovation to their own contexts.

How to make information handling more effective? A tendency exists in school personnel to ask for more information than they really need. They do this with little realization of the cost implications of their requests, or the inconvenience they have to undergo in providing the required data. When the data identified for collection far exceed the minimum requirements, the systems tend to get extended beyond their initial terms of reference. This problem of over design, according to Zanuttini (1982), makes those handling information to develop complex forms for data collection. Lack of a basic system structure for the information systems is another problem in information handling. This reduces the comparability of data both at different levels of the system and also at different institutions of the same level. On-going change and development also brings to light new information needs and makes the structure of the information system to be changed from time to time. To overcome these problems, a need exists to view all information requirements in totality at the inception itself and specify clearly the objectives of the information system.

What communication channels to be used? The success of any innovation, according to Willis (1990), depends on the extent to which people involved in the change accept it, and are committed to it. Although this requires communication in all directions of the organisation, the little attention paid to allocate sufficient budget and personnel to this important aspect has not allowed many schools to go beyond a newsletter or a query answering service. Administrators also do little to keep the staff informed of the policy, philosophy, implications and the progress of the innovation. This situation, according to Gathercoal (1991), creates a discrepancy between the ostensible policy and the policy at work. Although the need for communication with one's peers is also crucial, many schools do not have structures for teacher communication and collaboration on a regular basis.

An electronic network that links the project office to the schools is a good means for communication. Such networks, once installed, bring drastic reductions in communication costs. Many developing countries, however, do not have the necessary infrastructure to employ modern strategies for communication. Telephones are not common in developing countries. Even if all schools under the project have access to the facility, this on its own fails to be successful as a communication device for the limited audience it can cover at one point in time. Newsletters overcome this difficulty and make communication more systematic and regular but require special staff and additional funds. Written correspondence provides an easy and cheap means of communication. Time constraints on the part of the leaders, however, can make this method ad hoc and less systematic especially when the project gets large and complex. Personal visits to schools by project leaders facilitates face-to-face interaction. Although this provides a very effective means of communication, costs in terms of time, effort and funds may limit the frequency of such visits, and bring down the effectiveness of the strategy.

Who should be responsible for the overall co-ordination of the project? The NREL (1988) identified five aspects of technology that help define the role of the project co-ordinator. These are administration (budgeting, facility planning, supervision, consulting), teaching (course design and instruction), software management (selection and evaluation of software), technical support (selection and management of hardware, minor repairs), and communications and outreach (serving on advisory boards, preparing newsletters, developing proposals). A project leader, according to Barone (1988), can be an information strategist, a custodian of machines and data, or a technology problem solver. One professional, when entrusted with the responsibility of implementing the change, has a rare chance of being proficient in all of the above aspects. This person also may not have the time or the capacity to oversee all activities satisfactorily, and respond to problems adequately. It may also not be possible for one single individual to channel the organisational and political support demanded by the innovation. The short time period within which the innovation has to be completed can further complicate the task of the appointee.

Co-ordination also can be in the hands of a multi-disciplinary central taskforce. This option not only enables different levels of the system to be represented in the overall co-ordination of the project but also provides an effective means for assessing the multitude of factors involved in the change. Co-ordination through a taskforce also ensures continuity in leadership and support for the innovation, but may prove ineffective when the taskforce is too big, or when the group leader is not acceptable to the majority.

Individual members functioning at different levels of the hierarchy also can be responsible for co-ordination. This arrangement helps motivate enthusiastic staff at all levels but may lead to duplication of effort when improperly planned.

How to improve project co-ordination? Co-ordination, according to Callen (1987), cannot guarantee creativity but it can reduce unnecessary duplication of expensive facilities and programmes. This situation requires a simple, but effective, co-ordination mechanism reinforced by external support to be identified well in advance of the change. Such action, according to Zanuttini (1982), allows adequate time for deliberations, and avoids chaos in implementation. Co-ordinators appointed also have to be competent both technically and professionally. This enriches the project not only with knowledge and skills in technology but also with experience in education. Providing all co-ordinators a prominent position in the hierarchy is another important consideration. This strategy makes it easier for the co-ordinators to win the acceptance of their peers, and provides them the authority they need to influence others in the required direction. The co-ordinators also need to be provided with continuous training. Enlightening these personnel with the latest knowledge and skills in the field, enables them to provide a better service to their peers.

Co-ordinators at the school level generally suffer from above average workloads. Additional responsibilities are entrusted to them with no release time from their normal teaching duties. Being computer literate, they also become replacements for various clerical help needed by their superiors. All of this, according to Makau (1989), hinders the most important professional role of the co-ordinator. This problem can be overcome by clearly defining the role and the responsibilities of the co-ordinator and making these known to all concerned. Such clarification also helps assess the staffing needs of the innovation more appropriately and enables the schools to make better use of their scarce computer literate staff.

What type of support does the innovation need? No innovation stands alone. Each demands support from both within and without the organisation. As Persky (1990) noted, a new and unfamiliar area like computer technology needs even more support than usual. Irrespective of this need, people involved in the innovation tend to work in isolation. Scarce team work neither allows political support for the innovation nor adequate grounds to assess the multitude of factors involved in the change. Collaboration across schools with regard to innovations is also insignificant. This situation reduces grounds to exploit the existing knowledge and experience of those dealing with similar endeavours. School personnel also can expect little by way of concrete support from the society. The novelty of the innovation delays the establishment of a network of individuals who are competent in technology. International technical support, when involved, also fails to work satisfactorily within a framework developed by national officials.

Provision of most support services is both difficult and expensive. Being a highly labour intensive activity, this consumes a continuing large cost rather than a one-time capital cost. As Emery (1984) noted, the inflation in salary related costs makes the situation even worse. The service organisations also need equipment for training as well as for evaluation and adaptation of software. According to the Commonwealth Secretariat (1987), extra equipment is needed to permit a generous attitude towards schools in their requests for short-term replacements. As Willis (1990) noted, expertise in technical support is focused on the type of equipment. This requires adding technical staff, or retraining existing staff each and every time a new technology is integrated into the system. The problem, however, can be overcome by identifying all related support services at the inception of the innovation.

Support can be organised in a variety of ways. Depending on the size of the country and the scope of the computing endeavour, many educational authorities tend to organise this on a national or a provincial basis. Centralised support is possible only when the computing endeavour is narrow in scope. Total dependence on this type of support can also prohibit timely services to project schools, particularly when they are well distanced from the central support service. This problem makes it well worthwhile to restrict this type of support only to certain services that enable economies of scale. According to the Commonwealth Secretariat (1987), some of these areas are staff development, hardware supply and maintenance, and software development.

The multi-echelon approach for user services, suggested by Emery (1984), identifies relatively low-skilled personnel at the level nearest to the user to meet simple support requirements. The service is shifted back to the central professional staff only for technical problems that can not be handled effectively at its origin. These problems require a higher level of skill and significant commitment of time. The adoption of this approach also allows people already in service to be developed for support services. Thus, it is not only less expensive than centralised support but also a motivator to staff with competence. As Makau (1989) and the NREL (1988) noted, the early technology adopters who have developed expertise well above their peers can be of immense use in providing this type of support. The success of the multi-echelon approach, however, depends on the availability of strategies that minimises face-to-face support.

Who should undertake follow-up? The project leaders often expect that people once trained will decide for themselves how they are going to use the newly introduced equipment. This, according to Plourde (1989), is not a valid notion. As Glen and Carrier (1986) indicated, a need exists for the training programmes to be followed-up by additional on-the-job training. Efforts of this nature also ensure proper utilisation of the expensive hardware and software.

School personnel can get on-the-job training either through project leaders or through their regular supervisors. No matter who undertakes the task, the persons responsible need to have the capability of initiating and maintaining professional interaction with the users. Although the project leaders are more capable in this regard, the large number of schools to be covered and many constraints in the budget may restrict their school visits. The school visits of normal supervisory personnel are also few in number. Moreover, such people are less oriented towards development and try to contend themselves by helping subordinates in their day-to-day administrative matters. Unless special arrangements are made to train this group of personnel, they also lack adequate preparation to provide the required guidance. Involving project co-ordinators at different levels of the hierarchy, eliminates problems associated with both options above. Closer to the end users and well trained in project activities, they are in a better position to initiate the needed professional interaction.

What to evaluate? Even in the developed world, very little evaluation has been conducted on the impact of computers in education. Hawkridge *et al* (1990), identified computing as the least evaluated and most expensive innovation in education. Evaluation helps project leaders identify problems central to the project, and facilitates smooth transition from the experimental to the operational stage. Schools outside the project also find evaluations useful, particularly in planning for future development.

The evaluators normally compare the costs, effects, and the broader individual and social benefits that can be attributed to the project, with alternative uses for the same educational resources. This helps them assess the worth of the project over other priorities. Some try to determine the success of the innovation by a certain required outcome rather than by the growth of the people and the system they are within. Most of the evaluation reports discuss quantitative and financial aspects such as expenses by different items, the number of software packages written, and teacher access to technology in terms of the time spent. Many benefits associated with educational innovations, however, cannot be quantified easily. Restricting the evaluations mainly to measurable quantitative aspects prohibits the clients from observing the true state of affairs of the project. Qualitative aspects, for example, deal with items such as teacher familiarity with technical operations and software, and the level of satisfaction the users derive from the services. For the success of the innovation, the evaluators have to pay more heed to qualitative aspects that help replicate the innovation on a wider scale.

Who should undertake evaluation? The use of computers in schools can be evaluated in a number of ways. Many educators propose internal evaluations for the purpose while others stress the need for external bodies to undertake the task. Evaluation, when undertaken by people within the organisation, facilitates on-going reflection of the use of technology. This approach enables deviations from the pre-set goals to be identified and corrected immediately. Internal evaluations also reduce stress for the people being evaluated. Although this provides no additional financial burden to the project, the low credibility of the findings can make this type of evaluation more appropriate for the investigation of simple day-to-day tasks. People external to the organisation enable more comprehensive evaluations that are based on more appropriate criteria. External evaluations also enable the performance of schools to be compared with one another, and the exemplary practices identified to be disseminated to all concerned. In employing this method a decision, however, has to be made as to who exactly should undertake the evaluation. When the evaluators are left unspecified, national and state-wide evaluation systems tend to proliferate, and, according to White and Rampy (1983), bring about duplication of effort.

What action helps institutionalisation of the change? The proposed innovation attempts to introduce computers into a remarkably conservative and stable system. New policies and structures take decades to implement in these systems, where the schools also function with undeveloped infrastructures. Most schools either do not have access to electricity or obtain it from adjacent schools via extension cords. The power supply in these countries also undergoes various fluctuations. Power cuts, which are frequent, take considerable time to be fixed. Although battery powered systems provide a solution for the problem, people in these countries rarely make use of these devices. As de Vries (1988) noted, they instead, have learnt to live with the frustrations of systems breakdown. To overcome such problems and to speed up the change process, the project requires strong government action and support. Although an infrastructure of support builds up motivation and morale in implementors and facilitates institutionalisation, the reason that people even in advisory councils lack competence to advise the schools may not make this possible for developing countries at least in the short-run.

The school system in these countries is also developed as an orderly and authoritative institution characterized by a hierarchical organisation. At the school level, the head is looked upon by teachers as the sole source of authority. The low teacher-teacher interaction, and even the lower teacher-administrator interaction this brings about does not provide fertile ground for within-school professional discussion or dissemination of innovative ideas. The schools are also organised as independent units with little opportunity for school personnel to interact with one another to share resources, knowledge and experiences. Mawara (1986) identified this isolationism as another reason for the failure of technological innovations. Strong action on the part of project leaders can improve communication among project personnel and solve the above problem. Opportunities also have to be created for project personnel to observe, or at least read, what others elsewhere are doing.

The educational systems in developing countries, in their struggle to obtain suitable hardware and software for the innovation and train the needed staff, increase their dependence on developed countries. Although it is noble to share knowledge, the failure to consider self-sufficiency as the ultimate objective, hinders institutionalization of the change. The training of staff takes time and effort, but provides an effective way to address the issue of dependence.

The literature on gender inequity in education indicates that females in most societies are disadvantaged with regard to learning in mathematics, science, and associated technical disciplines as well as in taking up related careers. As Makau (1989) noted, the formal education systems of many developing countries with their biased learning materials inculcate this belief in school students. The society at large, and the parents also, socialize the students in a similar direction. Deep-seated prejudices of this nature tend to limit the participation of females in the innovation except in areas such as wordprocessing that are perceived as female domain. To overcome this problem, which also may hinder institutionalisation of the innovation, a need exists to select suitable females and appoint them as project leaders. Such action may change the notion that females are less rational and scientific and have little interest in gaining technical knowledge. It may also blur the distinction between male and female domains, but can cause problems when females show reluctance to undertake work that is biased in favour of males.

Research and Development

Research, according to Bork *et al* (1987), is an educational experience that liberates human potential for the solution of social problems. An organisation can gain immediate and direct benefit not only from the results of research but from the research process as well. A computerised administrative system capable of responding satisfactorily to the basic requirements of its users is not simple to create. Three to four years of research and development efforts may be required for this to provide any true operational service. According to Ilabaca (1991), research studies conducted in educational computing are also few in number, unclear, and contradictory even in the developed world. Nevertheless, as Hurley (1988) noticed, research demands continue to outpace research availability making it difficult for the planners in developing countries to neglect this task any longer. For improved performance, a need exists to create conditions for research and development.

How should the research effort be organised? With no doubt as to the importance of research and development, the organisation of the research effort becomes a major concern. Should this be funded from sources outside the country? Should it be organised centrally or be decentralised to lower levels? What systems and procedures should be adopted to make it more effective? are some important issues to be addressed.

Centralised approaches provide more opportunity to support the research function through external funding. Such approaches also enable regular meetings where research methods, instruments, and findings can be discussed. These meetings provide a forum to look critically at the progress of the project, relate interim findings to research objectives, initiate timely corrective action, and plan forthcoming activities. Periodical reports enabled by this approach also facilitate sharing of ideas on a regular basis. Decentralised approaches to research enable problems specific to the localities to be investigated but may blur the specialist role of the research scientist, and hide it among the day-to-day tasks of the practitioner. Research undertaken at a low level also may not be easy to support.

What types of research should be encouraged? Different types of research help achieve different types of objectives. Evaluation and comparative research help rationalise the best structure and organise activities in the most appropriate manner. Exploratory research enables modernisation of technology. Action research facilitates documentation of the implementation aspect and provision of feedback for both policy and programme revision.

What areas should be researched? Research, according to Wan and Li (1988), can have different orientations. Some researchers emphasize the modernisation of educational technology, further development, and policy making. Others emphasize the existing problems and the improvement of current systems. Amidst these varying orientations a need exists to identify the most suitable areas for research.

The success in administrative computing requires better approaches to educational administration. When research efforts are in this direction, existing systems can be improved and the syndrome of reinventing the wheel can be avoided. World-wide activities in technology is another area to be investigated. Researching this area enables institutions to adopt modern methods, develop better policy, and cope with the rapidly changing technology. Software evaluation, when undertaken as a research activity, helps identify software that can be easily adapted to school needs. Implementation is also an aspect often investigated. This provides ample opportunity to replicate the project on a wider scale. Research in this area also enables the development and maintenance of an information technology profile for the system as a whole as well as for the individual schools. When the impact of computers on school administration is selected as a research topic, the baseline status of schools involved in the project has to be identified together with their short- and long-term achievements. Cost implications of the innovation, another area to be researched, can highlight any inefficiencies of the project along with their monetary values.

Summary

The sources and strategies of funding are two important concerns in technology-related innovations that involve high costs. Ways and means of budgeting in a technological environment and allocation of scarce financial resources for optimum benefits are two other fiscal concerns discussed. Managerial issues covered the areas of policy making, information management, planning, communication, co-ordination, support, follow-up, and evaluation. The chapter also discussed organisational aspects of the innovation both at project and school level. Since development is an important managerial concern, the issues in the area of research and development were also considered. Particular attention was paid to the organisation of the research effort, the topics to be researched, and the research methods to be used.

Chapter 10

A Draft Policy for Computer-Based School Administration in Sri Lanka

Introduction

The purpose of this chapter is to propose a policy for computer-based school administration in Sri Lanka for the consideration of educational policy makers in the country. As a preliminary step in developing this policy, Chapter 7, Chapter 8 and Chapter 9 presented a set of key issues in the areas of people, technology and management, and analyzed each issue to arrive at two or more methods of resolving them. A review of the experiences of others who had adopted these strategies in the past brought to light both strengths and weaknesses of the strategies. In some cases the strategies identified were complementary in nature and could be implemented satisfactorily as a whole. In other cases where this was not possible, one strategy had to be selected over the others. With regard to cases of the latter type, the issue was discussed in such a way to highlight the strategy that seemed most appropriate for the developing country context. In some cases the strategy identified was a combination of two extreme methods. The combined strategy allowed the strengths of the two individual methods to be reaped and provided a better approach for resolving the problem. The main purpose of this chapter is to present the outcome of the above analysis in the form of a policy.

The Mission Statement

The education system of Sri Lanka is founded upon the philosophy that, in a dynamic society, the schools should develop a sustained capability to respond efficiently and effectively for the qualitative transformation of education. In the development of critical and creative thought processes, innovative management that deals with anticipated problems will gain priority over maintenance management that considers known and recurrent situations.

The Rationale for Computer-Based School Administration in Sri Lanka

Technology has great impact on organisational performance. The new structures, processes and control systems that result from conscious decisions of management to adopt computers have to be followed through the transition with no disruption to the smooth functioning of the organisation. As Hawkridge *et al* (1990, p. 25) noted, "Without a policy computers arrive in an unco-ordinated fashion. Teachers are not trained. Software is scarce. Hardware is incompatible. Spares, repairs and maintenance hardly exist. Expensive private schools probably survive best with a network of foreign contacts quickly widening the gap between their students and the rest." Besides the above problems, the magnitude of the investment for this innovation cannot allow any form of mistake. A policy that helps the constituencies to share the same technological vision is, therefore, needed for the schools to avoid detours and to attain the pre-determined goals of the project with minimum delay.

The aim of this innovation is not to spread benefits thinly to the greatest possible number of students, or to help them towards computer related jobs, or to improve teaching and learning, but mainly to promote change in the education system to help those schools that cater to the educational needs of the most academically talented students of the country to achieve excellence. The rationale behind the innovation, therefore, is catalytic, and not social, vocational or pedagogical.

The Policy

In their quest for excellence for the most academically oriented students of the population, the educational authorities of Sri Lanka recognise the need to initiate administrative computing in all schools currently designated as national schools and also in any other school that will be elevated to this status later. It is the policy of the authorities to cater to the maximum development of the students of national schools by enhancing the opportunities available to the administrative, teaching and support staff of these schools for productive developmental work. Computers will be used to relieve the above staff categories as much as possible from day-to-day routine maintenance work which currently consumes a major part of their time.

The proposed policy for administrative computing is not a blueprint for action. Taking into consideration the unique nature of schools the policy will be kept adequately flexible for adaptation by individual schools to suit their own needs and conditions.

Guidelines

1. The innovation will comprise three phases - planning, preparation and implementation.

2. The central co-ordination of the project will be by a five-member committee,

which as a group, is technically and professionally competent. The project also will have co-ordinators at the provincial and school levels.

3. The organisation of the project will consider both the dangers of excessive centralisation and technical anarchy.

4. The total capital cost of the project will be borne by central authorities. Matched funding will be considered with regard to recurrent costs.

5. The research and development effort will be centralised with funds channelled from international sources.

6. The research team will consist of five members, all educationists.

7. All hardware, software and training decisions will be based on research that will take into account the experiences of others well advanced in educational computing. A thorough survey of the users will allow their ideas and opinions to be incorporated into central decisions.

8. The educators will not be required to develop software since this is not part of the educator's training or expertise. For the most part, generic software will be defined appropriately to meet the needs and conditions of both the users and the organisation. Wherever this is not feasible, a small team consisting of software professionals and educationists will bring together programming skills and educational perceptions, and engage in software development.

9. All hardware will be centrally acquired and distributed to schools. Hardware acquisitions will be phased-in to ensure availability of funds for other areas (software, staff development, support) which are identified as important.

10. Maintenance, mainly in-house, will be undertaken by a central group specifically trained for the purpose. The co-ordinators at different levels also will be trained to undertake minor repairs. External expertise will be sought only to train the core group at the centre.

11. Trainers will be mostly educationists selected from among those co-ordinating the project at different levels. The services of technologists will be used only for the training of trainers.

12. All training will be organised centrally. This will cover project co-ordinators and supervisory staff at all levels, end users, top level administrators responsible for policy, and the maintenance staff. Continuous training will be encouraged for all client groups with a higher frequency for the trainers.

13. Follow-up will be regular as far as possible. The main responsibility for this activity will be with the co-ordinators at the provincial level.

14. Evaluation of project activities at the school level will be both internal and external. Both supervisory staff and project personnel at the school level will be responsible for internal evaluation. The research team will undertake external

evaluation on a periodic basis. Outside consultants also will be channelled for evaluation at a later stage.

Indicators of Effectiveness

The policy and its implementation will be considered effective if (1) computers are purchased and installed in schools within the planned time limits; (2) applications are successfully installed to cover the priority areas selected for computerisation; (3) all client groups identified for training have received at least the first cycle of their training; (4) the demand for further training is on a rising trend; (5) paper work in the system and the time spent on routine administrative work are much less than earlier; (6) the idle time of equipment is low; and, (7) the staff, on their own, identify new areas for computerisation and implement them.

Project Phases

The project consists of three major phases planning, preparation and implementation. Planning for the innovation will take into consideration the rationale for the use of technological products in education, determine the role of the computer in national school administration, and formulate a suitable policy to guide action of implementors. In planning, attention will be paid to both short-term and long-term needs, and the emphasis will be more on effectiveness than on efficiency. Preparations will include fund generation for the project, purchase and installation of hardware, meeting of software needs, training of staff, and pilot testing of administrative applications earmarked for implementation. In the final stage of implementation, all applications that pass the pilot test will be disseminated to all project schools, and implementation will begin in a pre-determined priority order.

Implementation plan

Co-ordination of the Project

The central co-ordination of the project will be by a project team consisting of a project director and four other staff personnel centrally appointed. The project director will be a high ranking educationist with knowledge and understanding of computer technology. Of the remaining four members, two will be educationists with expertise in computing, one a technologist drawn from outside of education, and the other an expatriate consultant with work experience in developing countries.

The project also will have co-ordinators at the provincial and school levels. The co-ordinators at the provincial level will be selected by the Provincial Directors of Education (PDE) from among the education officers serving in their areas. Expertise in technology, interest in educational computing, and acceptance by subordinates will be the major criteria for this selection. The co-ordinators at the school level will not be appointed immediately. Adequate time will be allowed for personnel with interest, capability, and recognition of their peers to emerge gradually. The deputy principal (administration) will be responsible for the school level project activities during the first year of implementation. At the end of this year, a team at the provincial level headed by the provincial level co-ordinator will consider three nominations made by each school principal to select suitable candidates for the posts vacant at the school level.

Except for the expatriate consultant and the technologist on the central team, all other appointees will be seconded to their respective positions with an additional allowance for the extra duties they perform. The normal workloads of these personnel also will be reduced at least to one-half the original amount. The international agencies supporting the project will be requested to cover the cost of the expatriate consultant. All local staff recruited will sign a contract with the project to ensure continuity of service for at least three years.

Management Strategy

The management strategy adopted during the initial stage will be mainly consultative. Contributions will be encouraged from lower levels, while some control will be retained at the top. The techniques adopted will take more of a participative nature once the people involved in the project gain more knowledge and skill in computing. A number of taskforces will be formed to co-ordinate different aspects (fund raising, software, hardware, training, evaluation) of the project. These task forces will draw on people from the central team, supervisory staff at intermediary levels, and co-ordinators at the school level.

Financing

Costs, both capital and recurrent, will be computed on the basis of unit costs, and will be considered from the outset itself. A large portion of the finances needed for the innovation will come from the public budget. Long-term debt will be considered only in the event of severe financial difficulties. Matched funding will be encouraged for recurrent costs. To facilitate this type of funding, the parents will be asked to contribute to a special computing fund on the basis of their income. Donations from well-wishers will also go into the same fund. Cost sharing will be permitted only among educational institutions. Cost saving will be encouraged only when quality can be maintained at the desired level. All hidden costs associated with cost savers will be properly illustrated in accounts. The schools will be encouraged to identify special projects in the area of administrative computing. Funds will be allocated to these projects once they are approved by a review committee at the central level.

Research and Development

The first phase of research will commence with the appointment of the project team. Taking user opinion into consideration, the team will review and refine the policy originally formulated, and the priority applications identified for implementation. Any technological developments that have proved successful in schools also will be considered at this stage. To facilitate preparation for the project, the team will also spell out hardware, software and training needs more precisely, and identify suitable strategies for hardware selection, software adaptation and staff training. A pilot project will be launched in one national school to get firsthand experience on the applications earmarked for implementation. The research effort, originally undertaken by project leaders, will be later entrusted to a five-member research team officially appointed for the purpose. Initiating the second phase of research, this team will look into the implementation aspect of the innovation. Regular meetings will encourage interaction among the researchers. Quarterly reports will disseminate their findings throughout implementation. A third phase of research will follow, mainly to ascertain the impact of the change, its cost implications, and possibilities available for further improvement and modernisation. Three research strategies, comparative research, action research, and evaluation research will take prominence in the three stages identified for research.

Training

Staff development will commence early in the innovation simultaneously with other preparations for hardware, software and support. In-service training will be the major mode of staff development. Programmes organised in this connection will be planned and conducted separately from other courses. Pre-service training will incorporate administrative computing only as another topic in the normal syllabus.

The project team will undertake all initial training with the help of outside experts as and when necessary. Courses will be designed centrally on the basis of research conducted previously. The first two courses will focus on the training of trainers and familiarisation of administrators. Co-ordinators at the provincial level will be the first participants in courses organised for trainers. Capable staff at the school level will be drawn in later for these courses. The administrators will incorporate policy makers, supervisory staff at intermediary levels, and principals of national schools. The training provided to this group of personnel, less technical, will focus upon the policy and managerial aspects of the project. End-user training will commence only when the trainers are ready to pass on the knowledge and skills they have acquired in their training. End-users will comprise members on school management teams, other staff with supervisory responsibilities, and teaching and support staff personnel currently involved in routine administrative work. Two participants will be selected from each school for each task to be computerised. One will be the current manual performer of the identified task. The other will be somebody in the younger age range with interest and skill in computing.

The workshops planned for administrators will be introductory in nature with a duration of three days. Such workshops will be organised once every year to keep the clients up-to-date with the changing technology. The trainers-to-be will obtain advanced training in the first cycle itself. Initial training for this group will cover a period of six weeks. Centrally organised workshops at least thrice a year will refresh the knowledge and skills of the trainers. A centrally organised forum once every year will provide an opportunity for co-ordinators at the school level to exchange ideas and views. The first cycle of training organised for end-users will be introductory in nature with a duration of two weeks. The trainers, already trained, will undertake this in a central location under direct supervision and guidance of the members of the project team. Subsequent monthly meetings at the provincial level will clarify any doubts the end users may have. For continuity in training, the end-users will be exposed to centrally organised advanced training at least once every year.

All training will be conducted during the normal work day with no cost to the trainees. To facilitate smooth functioning in a technological environment these courses will not restrict themselves to technology-related aspects, and cover other areas such as policy making, planning, budgeting and supervision. The training provided for trainers and end-users will pay more attention to the former while the training organised for administrators will focus mostly on the latter. The training planned for trainers and administrators will be general in the sense that all participants in a given group will receive the same training irrespective of their interests and capabilities. The end-user training will pay more attention to the specific needs of individual participants. The hands-on sessions and work assignments organised for this category of trainees will take such needs into consideration.

All training organised centrally will be formal. The didactic method will be preferred over the discovery method to enable quick functionality and confidence on the part of trainees. Except for the administrator training, two-thirds of the time allotted to other training programmes will be devoted to practice, with only one-third of the time devoted to theory. Language- and print-related modes will take prominence in the early training programmes. Print-related modes will be continued even after the formal training to keep participants abreast of new developments. Observations will be encouraged with the development of exemplary school practices. Technology-related modes of training will be undertaken only when the project is ready for individualized training with adequate hardware, software, and expertise.

All training will be followed-up periodically by those in authority. The project team will visit training sessions at the provincial level at least thrice every year, and the project schools at least once every year. The co-ordinators at the provincial level will visit schools in their jurisdictions at least once every month.

Technology

A threshold package consisting of hardware, software, and computer consumables for the first year of implementation will be determined centrally for all schools in the project. Acquisitions will begin with the invitation of tenders. A sales contract that incorporates carefully thought out terms and conditions will be signed for all purchases.

Software

Software acquisition and development will be co-ordinated by central agencies on the basis of goals and priorities identified for the project. All software will be thoroughly evaluated prior to purchase with special attention paid to user friendliness and availability of documentation. Software reviews will help identify software during the initial stage. Word of mouth also will be used to channel ideas from business and industry.

Adaptation of generic software will be the main means of satisfying the software needs of schools. The development of software will be undertaken only when adaptation of software is no longer feasible. A mixed team comprising software professionals and educationists will undertake this in accordance with pre-specified software standards. These standards will be revised periodically to prevent working with obsolete hardware. The project personnel on their regular follow-up visits will try to identify worthwhile developments in software both at the provincial and school levels. These will be documented and distributed to all project schools.

To minimise liability related to the creation and adaptation of software, ownership rights will be clarified well in advance, and expressed in employment contracts for staff and in enrolment contracts for students. Site licenses will be negotiated with software companies to minimise liability associated with software use. Back-ups will be encouraged to minimise frustration due to damage of software and loss of data.

Hardware

Micros will be the only type of computer the schools will be equipped with in the short-term. These will be acquired centrally from among models that have shown success in the developed world. All computers will work as separate systems during the first year of implementation. Networking will commence as soon as the provincial Departments of Education are provided with mini-computers. This distributed network will be extended to the national level later to incorporate the mainframes at the central Ministry of Education. Internal networking will be considered when the schools have at least five microcomputers inclusive of those used to teach Computer Science to senior students. Dot matrix will be the main type of printer made available to schools. The schools, however, will have access to laser printers at the Provincial Departments of Education for work that demands high quality printouts.

The equipment identified for use in schools will be acquired on a phased-in basis. Each school in the project will initially receive two microcomputers and one printer. The other equipment earmarked for schools will be provided subsequently on the basis of the enthusiasm and the progress shown by respective school personnel. All computers installed at different levels of the system will be compatible with one another and also with the software identified for use. Hardware standards will be reviewed periodically to keep the system in line with evolutionary patterns observed in technology. All initial machines, although average in terms of memory size, speed, and storage capacity, will have sufficient room for further expansion.

Preventive maintenance will be organised in-house. The central maintenance unit will undertake all major repairs. The co-ordinators at different levels of the system will be trained to undertake minor repairs. All available machines will be scheduled for use during the entire school day. To ensure optimum use of equipment, the co-ordinators also will keep records of utilisation. The school policies will indicate clearly the kind and amount of personal use one can make of the institution's computing facilities. The maintenance unit will hold standbys to prevent stoppage of work due to equipment breakdown.

Information Management

For better decisions with respect to the change under concern, special attention will be paid to improving information management. A computerized information system with focus on this particular project will initiate this activity.

Communication

Written records will be the major mode of communication in the early stage of the innovation. This will be supplemented later by a newsletter. With the inception of distributed computing an electronic network also will be considered for the purpose.

Support

A network of competent people from business, industry, and higher education will be established as a means of outside support for the project personnel. Peer support will be encouraged as the major means of internal support.

Follow-up

The central project staff in conjunction with the co-ordinators at the provincial level will be entrusted with the responsibility for follow-up. The regular visits of the latter is expected to compensate for the less frequent visits of the former. Important observations made in the follow-up visits will be recorded systematically to be used in future planning.

Evaluation

Evaluation will be mostly by end users themselves and their immediate supervisors. To make up for the low credibility associated with such evaluations, the research team will undertake more comprehensive evaluations periodically. These will cover both quantitative and qualitative aspects of the innovation.

Both follow-up and evaluations will attempt to identify exemplary staff practices. Recognizing the people responsible for these activities and providing them with more opportunities to perform better will provide the major tool for staff motivation.

Planning at the School Level

The computing plan, based on the long-term strategic plan of the organisation, will extend logically from the present situation to cover new and emerging needs of the school environment. The plan also will pay adequate heed to other plans of the system which could affect or be affected by the proposed change. To make planning incremental, on-going, adaptive and self corrective, an annual implementation plan will be formulated yearly within a long-range rolling plan that covers a five year period.

Organisation at the School Level

During the initial stages of the innovation the computers will be housed as close as possible to the users. Later, with the availability of more machines, arrangements will be made for centralised housing of equipment. A secure room in a quiet location will be adapted suitably to meet the special needs of the expensive hardware. Special attention will be paid to the physical security of equipment. Access codes will be introduced to protect the privacy and confidentiality of school records. Security systems will be changed from time to time to prevent people from becoming familiar with them. Insurance will be obtained to provide coverage for any possible losses.

Academic and administrative computing will be integrated with other information-related functions at the school level to be managed as one single entity. The co-ordinators of the integrated units will comprise the management committee responsible for the overall information aspect. The head of this committee will be a member of the school management team. The roles and responsibilities of all co-ordinators will be defined clearly along with those of the committee as a whole, and will be made known to all concerned.

Summary

The project co-ordinated at the national, provincial and school level of the system will consist of three major phases planning, preparation and implementation. Adequate time will be allowed for school level project co-ordinators to emerge gradually. The training organised will focus on co-ordinators, administrators and end users. Adaptation of generic software will be the main means of satisfying the software needs of schools. Hardware will be acquired on a phased-in basis and maintenance will be mainly preventive. Special attention will be paid to the security of hardware, software as well as data stored in the systems. Evaluation will be both internal and external. The research effort, in the hands of a five-member research team, will extend from the pre-implementation to the post-implementation stage of the project.

Chapter 11

Conclusions and Recommendations

Conclusions

This study focused mainly on identifying and analyzing policy-relevant data in the area of educational computing. The draft policy illustrated in the previous Chapter summarized the outcomes of the above process with particular reference to administrative computing in the national schools of Sri Lanka. The main purpose of this section is to identify and illustrate other important conclusions of the study that are not specified in the draft policy.

1. Computers have a great deal of potential in school administration. Any effort to realize this potential of the computer will create a number of issues and problems for policy makers.

2. The effects of administrative computing on schools can be positive, negative or neutral. The actions of policy makers largely determine the nature of these effects.

3. Continuous perusal of literature on educational technology is needed to provide useful information to educational policy makers for future-oriented planning and policy making.

4. Analytical research that describes and interprets the past from available sources was valuable for its ability to generate a large quantity and variety of policy-

relevant data in a comparatively short period of time. The technique of content analysis also used in the study helped derive meaningful dimensions from the data collected, and proved useful in a policy study of this nature where all information comes from documentary sources.

5. A "study for policy" when guided by a "study of policy" can result in defensible policy advice.

6. Introduction of administrative computing in schools will place increased demands on school personnel. The need for pre-service and inservice activity along with the need to operate two systems (one manual and the other computerized) simultaneously at the outset will reflect this increased demand.

7. The identification and analysis of needs and problems of school administrators help identify a suitable role for computers in school administration.

8. For maximum effects, the software decisions have to be based on the role identified for computers in school administration. Hardware decisions have to follow software decisions.

9. Wordprocessing and information management top the list of priority applications identified for implementation. The simplicity of the task and the urgency of the need favoured the selection of the former. The need for accurate and reliable information for successful accomplishment of all other tasks identified for computerization led to the selection of the latter.

10. People issues should gain a high priorty in technological innovations because people enable the true potential of the technology to be realized.

Recommendations

The recommendations highlighted in this section will be for three groups of people - the educational policy makers of the country under concern, educational leaders of other countries interested in this type of innovation and future researchers.

Recommendations for educational policy makers of Sri Lanka. There is always a time lag between policy formulation and implementation. The outcomes of the study that are time bound can become obsolete during this period. This situation requires the literature to be reviewed continuously to identify and incorporate new technological developments that have proved successful in other educational settings.

The task of policy making conducted in this study was solely on experiential knowledge and researcher opinion. The high reliance placed on the will-of-the-expert enabled a vast search of literature and a thorough processing of needs along with best available analyses and advice. The experts, however, have their own biases, prejudices and preferences. This situation requires the policy developed to be refined by taking into consideration relevant political inputs. The will-of-the-people considered thus can lead to a more tenable policy.

Some national schools are larger than the others in terms of student and teacher numbers. Some located in urban areas enjoy more community support than the others.

A few are compartively new while the rest have existed over long years in the past. Such differences require a number of groups to be identified within the national school system for more detailed planning.

A needs assessment in the selected schools is important in determining user opinion. Discussions have to be arranged with school pricipals to see if they agree with the needs already identified by the researcher. Observations in schools are also required to ensure that all worthwhile administrative problems encountered by school principals are taken into consideration. Both of the above actions will bring to light any changes needed in the exisiting structures and processes. Such actions can also help refine the priority applications identified for implementation.

The policy formulated in this study provides general indications as to what to do and how to do it. More detailed analyses, therefore, are needed to facilitate planning and preparation for the change. To cite a few examples software, hardware and training needs have to be spelled out more precisely and suitable strategies have to be identified for software acquisition and adaptation, hardware selection and staff training. Evaluations have to be conducted to select the best packages available for software, and appropriate models for hardware. The attributes of hardware such as memory, speed and storage capacity have to be determined on the basis of student numbers in schools. The users have to be consulted to see how familiar they are with computing and to group them suitably for training.

Formulation of a policy does not necessarily lead to implementation. The funding agencies have to be convinced of the true merits of the proposed change. This requires elaborate cost-benefit analyses in addition to a descriptive justification of the need as done in Chapter 5. The study identified three alternative strategies for school administration. These are (1) continuing with the current method (2) Increasing clerical staff cadres at the school level, and (3) the introduction of administrative computing. All costs and benefits associated with these strategies have to be identified and laid down appropriately to highlight the real advantage of selecting the third option.

Based on the final policy, all levels of the system will be required to make decisions and establish their own policies to facilitate the task of school administrative computing. Since decisions made at the school level have the most significant impact regarding the effective implementation of the identified change, the school administrators need to be encouraged in formulating relevant policy at the school level.

Recommendations for educationists in other developing countries. The purpose of this study was to provide research-based advocacy for the introduction of administrative computing in the national schools of Sri Lanka. As a first step, a thorough search was made for the accumulated knowledge and experience in the area of educational computing. The data, so collected, were used to identify issues, propose alternative solutions, and to evaluate the alternatives. Data thus analyzed were laid out later in the form of a number of "what should be positions" to facilitate the task of people implementing the change.

Any country that is interested in educational administrative computing can make use of the policy-relevant information collected in the first part of this study. The issues, strategies and the trade-offs among strategies highlighted in the study can provide important implications for educational policy makers of any country as to how to go about a similar change. The "what should be positions" laid out in the policy, however, are directly relevant to the social, political, cultural, economic and technological context of the country for which this study was intended. Even though developing countries demonstrate many similarities in the above aspects, they also exhibit a number of differences. Some countries may have already reached technological independence with their own hardware and software industries. Some may have extremely restrictive economic policies that prohibit all technological imports. The large polpulations of some other countries may not be adequately educated to understand the value of information or the need for technology in schools. Such differences in the characteristics of the settings may require caution in generalizing the conclusions of this study to schools in other developing countries.

The schools of other countries also may not be comparable to the national schools of Sri Lanka. They may vary in terms of size, purposes, governance strucutres, community support, and administrative problems encountered by school principals. The prior exposure of staff members to computing and the resulting anxiety levels in them also may not be similar to those in the national schools. Moreover, all schools may not be equal when the extent to which they have met their basic needs and developed their infrastructural faciliteis are considered. Such differences also common to different types of schools within a single country can reduce the transferability of the findings from one type of school to another. The priority applications and the "what should be positions" identified by this study, therefore, may have to be refined taking into consideration the characteristics of schools of other countries that are interested in this type of innovation.

Recommendations for further research. The outcomes of all research studies are time bound. This is particularly true for research in the area of rapidly changing technology. To prevent schools from using obsolete hardware and software, future research should focus attention on new technological developments that have proved successful in education.

The success of any change is fundamentally linked to its implementation. This requires studies to look into the implementation aspect of the innovation. Such studies enable any deviations from policies and plans to be identified and remedial action to be taken before the problems get acute and uncontrollable. Efforts also can be made to identify common constraints that impede implementation. This action can bring to light not only new issues, but also better ways of addressing the old issues, and finally lead to more appropriate policies.

Studies that explore the impact of administrative computing on the school organisation are also of value. Better knowledge and awareness of both the positive and the negative effects of the change can allow more appropriate use of computers in school administration.

Finally, studies are needed to identify how this innovation can be extended to cluster schools of the country.

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